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ABSTRACT

A study identified trends influencing the literacy requirements of two entry-level jobs at each of three manufacturing sites and three hospital sites. Data were collected through observation, interviews, and focus groups with workers, employers, and union representatives. Materials that workers were expected to read were analyzed. The study concluded that: (1) job descriptions and training manuals were not reliable indicators of literacy requirements, but observation and interviews were; (2) entry-level manufacturing job literacy requirements vary according to the extent to which traditional assembly line work is being modified to a production team approach; (3) traditional assembly line work entails few job literacy tasks and minimal calculations; (4) quality control, the use of team approaches, the introduction of job rotation, and statistical process control procedures increase literacy requirements; (5) the jobs of entry-level dietary department workers and laboratory assistants in hospitals tend to be defined by the availability of skilled entry-level workers and by the need to cut the cost of professional salaries or to address a shortage of professional workers; (6) the complexity of menu-driven software and the use of technology also influenced the level of difficulty of those jobs; (7) employers do not always have the information they need to set hiring criteria; and (8) workplace literacy skills are different from those in academic settings because they are usually repetitive, performed cooperatively, and driven by procedural knowledge or oral instructions rather than written directions. (The document contains sample materials, copies of scales, and bibliographies containing a total of 112 references.) (CML)

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Final Report

RESEARCH IN WORKPLACE LITERACY: THE LEVEL OF LITERACY REQUIRED IN SPECIFIC OCCUPATIONS

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February 28, 1990

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RESEARCH IN WORKPLACE LITERACY: THE LEVEL OF LITERACY REQUIRED IN SPECIFIC OCCUPATIONS

Final Report

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J.G.G.
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EXECUTIVE SUMMARY

RESEARCH IN WORKPLACE LITERACY:

THE LEVEL OF LITERACY REQUIRED IN SPECIFIC OCCUPATIONS

FEBRUARY 28, 1990

The workplace literacy initiative of the Employment and Training Administration, ETA (U.S. Department of Labor), is concerned with developing programs that will enable workers to be more productive, benefit from training and re-training programs, and retain their jobs in a changing workplace. The view is widely held that the literacy skill demands of jobs are increasing, while the basic skills of the available workforce are decreasing. In funding this study, ETA sought to identify trends and tendencies influencing the literacy requirements of entry level jobs, while realizing that there were a number of dynamic factors at work making it difficult to assess definitively the requirements of specific occupations. ETA was particularly interested in identifying methods of looking at occupations relevant to JTPA and vocational education programs, distinguishing between the minimum requirements of jobs and the educational and skill levels established by company policies for hiring entry level workers, and gaining information on the literacy requirements of specific occupations.

Project Activities

In carrying out **The Study of the Level of Literacy Required in Specific Occupations**, RMC Research developed a research protocol and rating procedures for comparing the relative difficulty level of job literacy tasks. Project staff then field tested the protocol and procedures at three light manufacturing sites and three health care facilities. Field staff observed entry-level workers considered competent by their employers and asked them questions about their job literacy tasks as they performed them. Observers gathered materials workers were expected to read and interviewed employers and union representatives to learn about hiring criteria and job literacy requirements. Workers recently promoted from the entry level were interviewed to identify the literacy skills required for their new job as compared to those for their previous job. Focus group meetings with all workers interviewed and observed, and analysis of documents used by workers on the job, served as checks on the reliability of the observation data.

A job task description was written, documenting all literacy tasks observed. The most difficult reading, writing, computation, and verbal tasks for each job were then identified and documented in detail. After careful study, observers placed the most difficult tasks of each of the six jobs at the appropriate point on either a prose, document, quantitative or oral language rating scale. In this way, the most difficult literacy requirements of the jobs were identified and their difficulty level determined.

Results

The results of testing the research protocol and rating procedures showed that both were useful tools for conducting workplace literacy studies. Further, the field test demonstrated the importance of conducting observations and interviews of workers on the job. Job descriptions and standard operating procedures did not capture the way workers broke literacy tasks down to make them easier to accomplish or used one another as resources to gain information. Reading reference manuals and training materials was not usually essential to the job.

Field observers studied the literacy requirements of entry level workers in two jobs at each of three manufacturing sites and three hospital sites. A major factor influencing job literacy requirements was the way work was organized and the extent to which innovations were being implemented. One factory organized work in a traditional assembly line configuration. There, the job literacy requirements were minimal for entry level positions. A second site was in transition from traditional assembly line to a work team concept and had instituted statistical process control and quality circles training for all workers. The literacy requirements of the training were considerably higher than the requirements for day to day job performance. The third site had fully implemented production teams. The literacy tasks for this job were rated at or near the top of the scales for literacy task difficulty.

Observations at three hospitals examined the literacy requirements for entry level dietary department workers and laboratory assistants. The findings showed that hospitals defined jobs differently according to the skills of the workforce, the availability of qualified workers, and the cost and availability of professionals. The complexity of menu driven software programs and the use of technology also influenced the level of difficulty of the hospital jobs studied.

The literacy skill requirements of dietary department workers showed the most variability across sites. Nutrition assistants' most difficult tasks were rated near the top of the document reading and writing scales. Their computation tasks were also near the top of the quantitative scale at one site. Dietary aides did less reading and writing and at a lower level than did nutrition assistants. Usually they performed very low level computation tasks. Interestingly, although laboratory assistant's jobs were implemented quite differently at each of the sites, the difficulty level of the literacy tasks for all three was similarly placed at the high end of the scales for document reading, writing and for oral communication. Lab assistants performed only a few relatively easy quantitative tasks.

In this small sample, employers varied in the way they determined the educational and skill requirements for hiring entry-level workers. Interestingly, the entry level manufacturing and hospital jobs with the highest literacy demands did not require a high school diploma. Hiring decisions were based on screening methods that assessed the applicants' ability to perform actual job tasks or on the applicants' perceptions of their abilities to do so. One hospital laboratory required either prior experience or post secondary science credits of its entry-level workers. The two manufacturing sites having the lowest job literacy requirements were seeking workers with high school diplomas.

Conclusions

The research protocol and rating procedures developed and tested during this study enabled field observers to document job literacy tasks of considerable complexity and are likely to be applicable for studying jobs beyond the entry level. The resulting data have a number of applications for improving workplace basic skills programs, including developing curricula, lesson plans, and student assessment instruments for job-related basic skills training.

The results of the study lend support to the notion that employers do not always have the information they need to set hiring criteria, and that such criteria may be based on information that does not accurately reflect the literacy skills workers need and use on the job. Detailed documentation of job literacy tasks is useful for developing screening instruments for job applicants that require them to perform sample literacy tasks for the job for which they are being considered. Such information is also valuable to employers in planning for the impact of proposed changes in technology or job structure on the literacy requirements of jobs.

This study lends support to prior research findings that workplace literacy skills are different from those required in academic settings. Workplace literacy tasks are repetitive, are usually performed cooperatively and are driven by procedural knowledge or oral instructions rather than written directions. Such findings indicate that in devising assessments to predict the ability of workers to perform job literacy tasks, more study is needed concerning the difference between successfully responding to written simulation tasks and performing literacy tasks on the job.

I. INTRODUCTION AND BACKGROUND TO STUDY

Purpose of the Study

The primary purpose of this study was to design and field test a protocol for assessing and reporting the workplace literacy requirements for entry-level jobs, and to create a meaningful method for interpreting (for policy makers, business leaders, and educators) the information collected. During the field study, RMC Research sought to identify factors influencing the literacy requirements of entry-level jobs and to distinguish between the minimum literacy requirements for jobs and the educational and skills levels established by company policies for hiring workers. Information was also sought on the literacy requirements of the entry-level jobs studied. For the purposes of the study, workplace literacy was defined as the **integrated use of reading, writing, mathematics, listening, speaking and related cognitive skills to perform job-related tasks. This often requires the application of prior experience.**

Background to the Study

In March, 1988, the United States Department of Labor issued a request for proposals (RFP# DAA 88-48, 1988) in which it stated:

> There is a widely held view that many workers lack the basic skills to read, write, and compute while, concurrently, even the least demanding occupations are being upgraded, mainly through technological change. The exact dimensions of the conundrum may never be known because of the continuously dynamic interaction between labor supply and demand. Nevertheless, the identification of trends and tendencies can be useful in planning education and training programs.

The flow of information supporting the view described in the background to the RFP has increased in volume from a stream to a flood. A recent **New York Times** article (September 26, 1989, p.1), for instance, stated that, "New opportunities for workers with no more than a high school education are falling sharply. In 1987, 54.6 percent of employed workers were in this category; by the year 2000 it will be down to 46.5 percent."

A thoughtful analysis of the history of the perceived problem by the American Society for Training & Development and the U.S. Department of Labor (1988) described the historical background to the current transformation of the workplace. American business has depended upon a highly skilled elite of managers and engineers to become a world leader in technological development. American business has also relied on mass production technology, a relatively unskilled labor force and a huge local economy to maintain its competitive position. Yet integration into the world economy means this is no longer sufficient, for

> while these links between our human resource development system and the employer economy have given the U.S. competitive advantage during the early stages of new products and technologies, the nation is less competitive in later phases of mass production and technological dissemination. In the production phase of the competitive cycle, America does not compete well. (ASTD and U.S. DOL, 1988)

The shifts in the organization of production resulting from the scramble to become competitive have not been preceded by adequate modifications in educating and training the workforce. Two factors complicate the problem. The first factor is that two-thirds of those who will be the nation's workers in the year 2000 are already in the workforce (Johnston and Packer, 1987, p.75). To retrain this large a group of workers will be a monumental task. The second complicating factor is the make-up of the workers who will enter the labor force over the next decade. A majority of these new workers will be those people who either don't perform well in the current educational system or have not had much education. Young adults entering the work force will account for less than 20 percent of new workers, while women, immigrants and minorities will comprise 80 percent of new entrants to the labor force at the turn of the century (Johnston and Packer, 1987). In short, business and industry are faced with a crisis in the supply of a competently trained labor force.

The scope of the unfolding problem is potentially overwhelming. This relatively small study was designed to develop a method for measuring the literacy skills required for adequate performance in entry-level jobs in order to begin to quantify the problem. The study represents a modest step toward addressing questions such as: How large is the gap between the skills of the labor force and the requirements of business and industry? Are job-entry requirements unnecessarily screening workers out? Is it possible to arrive at descriptions of the actual literacy requirements for particular jobs or categories of jobs to provide the business, labor and education communities the information needed to develop the skills needed by the work force? Is it possible and feasible to systematically collect and analyze data on workplace literacy requirements in order to facilitate the development of policy initiatives by the U. S. Department of Labor?

Job entry standards for business and industry set by employers do not always relate directly to the skills required to perform the jobs for which employees are hired. In some entry-level workplaces, requirements have been set, for instance, by analyzing the reading levels of training materials developed for new employees; however, the reading levels of training materials may not correlate with the literacy requirements of the job. Many entry-level requirements were set during times of high unemployment when there was an oversupply of adequately educated job applicants, enabling employers to recruit overqualified employees. Entry-level requirements are also often expressed in terms of grade level achieved, yet researchers have found the literacy skills required to function effectively on the job differ significantly from those taught in schools (Mickulecky, 1982).

Literacy skills involve the interaction between the reader, the text, and the context of the reading situation (Michigan Task Force on Literacy's definition of reading, unpublished). In the workplace, the reader employs such skills as reading and writing ability, prior general knowledge, prior specific job knowledge, problem solving strategies, and interpersonal skills. The text with which the worker interacts includes a variety of print sources: manuals, blueprints, computer screens, charts, graphs, labels, schematics. The context of workplace reading includes the demands of the job tasks, the perceived purpose of using the material, and the availability of information from other sources: co-workers, supervisors, trainers. Academic reading, on the other hand, usually involves application of the reader's general knowledge and reading ability to reading textbooks or other prose. Such reading is usually done in isolation with the expectations of a teacher or the demands of an exam in mind.

Because of these differences between workplace reading and academic reading, recent research studies have used extensive observations and interviews of workers on the job, such as in the literacy audit described in The Bottomline: Basic Skills in the Workplace (U.S. Departments of Labor and Education, 1988). Data collected through a literacy audit enables researchers to identify and describe the job literacy tasks required of entry-level workers. There has not, however, been a means of determining the relative difficulty level of such tasks. Forms, charts, and other documents do not have sufficient text to be analyzed by traditional readability formulas. Furthermore, the reading grade level resulting from such analysis is not meaningful in workplace settings. An important goal of the Study of the Level of Literacy Required in Specific Occupations, has been to devise a meaningful way of assessing the difficulty level of documents, reading and writing tasks, and quantitative tasks performed by workers on the job.

Overview of the Study

The goals and field-based activities of the study can be divided into five separate components:

1. the creation and field testing of a protocol for collecting descriptive observational and interview data on the nature and extent of literacy tasks for entry-level jobs at the work site, and for collecting printed materials related to the job tasks;

2. the development and testing of a method for describing literacy tasks related to each job in enough detail and in a form suitable for later analysis;

3. the development and testing of a method for assessing the difficulty level of job literacy tasks;

4. the exploration of a means of matching job literacy tasks to the young adult literacy simulation tasks on the National Assessment of Educational Progress (NAEP) in order to relate task difficulty to the performance levels of a segment of those entering the workforce; and

5. the examination of the literacy level of selected entry-level jobs in the light manufacturing and health care industries.

These goals and activities were developed as a result of a review of related literature and upon the recommendations of an advisory panel.

Organization of the Final Report

Chapter II consists of a chronological description of project activities. Chapter III is a review of the literature on research in workplace literacy relevant to this study. The appendices of the report contain site portrayals describing the workplaces visited during the field study and examples of the way job literacy tasks were documented and their difficulty level determined.

Chapter IV contains the protocol for collecting data on job literacy tasks and the rating procedures developed to determine their difficulty level. It also discusses the usefulness of the protocol and rating procedures. Chapter IV includes:

- a discussion of the merits of the protocol for identifying the literacy requirements of entry-level jobs;

- a discussion of the usefulness of the National Assessment of Educational Progress (NAEP) Young Adult Literacy Simulation Tasks for assessing the difficulty levels of literacy requirements; and

- a description of the method developed for assessing the difficulty level of job literacy tasks.

Chapter V describes the findings from our study of entry-level jobs. These include:

- a discussion of the effects of the trends and tendencies influencing the nature and requirements of entry-level jobs; and
- a preliminary assessment of the literacy requirements of the jobs studied.

Chapter VI provides a summary of study outcomes.

II. DESCRIPTION OF PROJECT ACTIVITIES

Initial Project Activities

Initial activity centered around the definition of clear project objectives and the creation of a work plan which would anchor all subsequent project activities. A comprehensive literature search provided the basis for a preliminary working definition of workplace literacy and for proposed data collection and data analysis procedures. These were defined and summarized in a document presented to a panel of experts in workplace literacy in November, 1988. In addition, RMC Research (henceforth referred to as "we") used data from Workforce 2000 and the Monthly Labor Review: Projections of the Economy, Labor Force, Industrial and Occupational Change to 1995 to nominate several job categories from which to select jobs to be studied. The job categories included:

- marketing and sales;
- health care;
- hotel and food services; and
- administrative support.

We planned to select three broad job categories from this list and then to observe and collect data on the requirements of entry-level jobs at three sites for each job category.

During an initial planning meeting, the U.S. Department of Labor presented us with an alternative list of broad job categories ranked according to the Department of Labor's priorities for obtaining information on the literacy requirements for entry-level jobs. These categories were:

- health and human services;
- retail and wholesale trades;
- light manufacturing;
- entry-level office workers;
- road maintenance and infrastructure maintenance;
- temporary services; and

- auto mechanics and auto body workers.

We decided to defer a decision about which job categories to select until after the advisory panel meeting.

Advisory Panel Recommendations

An advisory panel consisting of :

- Luke Baldwin, Lesley College;
- Lee Bruno, Abt Associates;
- William Diehl, University of Michigan;
- Renee Lerche, General Motors Corporation;
- Larry Mikulecky, Indiana University;
- David Rosen, Adult Literacy Resource Institute, Boston;
- Kenneth Dickinson, UAW/Ford National Education, Development and Training Institute; and
- Daniel Vergeri, UAW/Ford National Education, Development and Training Institute

was convened in November 1988 to react to our detailed proposals for implementing the project.

We proposed that workplace literacy be defined as "the requisite range of reading, writing, math, listening, and speaking skills needed to satisfactorily perform the job." Further, we proposed to assess the literacy skills required of three job categories in three industries (a total of nine sites) and to report literacy requirements of these jobs by using readability formulas and by relating reading requirements to Chall's stages of reading (1983).

Discussion at the meeting of panelists initially centered upon a definition of the research questions to be addressed and the project's operational definition of workplace literacy. The panel considered our definition too narrow and recommended the following as an alternative:

> Workplace literacy is operationally defined as using literacy and related cognitive skills to perform job-related tasks. The performance of those tasks usually involves the integration of reading, writing, math, listening, speaking and prior experience.

This formed the basis of the operational definition of workplace literacy developed during the project:

> Workplace literacy is operationally defined as the integrated use of reading, writing, mathematics, listening, speaking and related cognitive skills to perform job-related tasks. This often requires the application of prior experience.

Panelists stressed that the project should provide basic research on the discrepancy between employers' perceptions of the requirements of entry-level jobs and the actual skills required to perform those jobs. Mikulecky's recent workplace literacy studies (1983, 1986) have shown that the interactions between task and literacy materials are critical to effective job performance, and that the nature of the task determines the way in which written materials will be used. Thus, assessing the difficulty of literacy materials in isolation from the task for which they are used provides potentially misleading information. The project should, panelists recommended, address the kinds of mental processes required to complete a job literacy task, the kinds of reading strategies required by print materials, and the nature of printed materials: prose, documents and forms, and calculations. Entry-level jobs are often repetitive and require small amounts of reading, but that reading may be key to job safety and productivity. The implication was that job-site data collection should be task rather than materials driven.

Research reveals that the extent, nature and level of reading for those new to a job may differ from that of those who are experienced (Mikulecky and Echlinger, 1986). Because of this, panelists argued that this project should collect data on job literacy tasks performed both by those newly hired to a job and by those with more than a month's experience at the position. The data collection process should also distinguish between literacy tasks necessary for the completion of a job task or satisfactory performance on a job (literacy requirements), and those which may be desirable and may extend the utility of the worker but which are not essential (literacy opportunities). Some panelists recommended the project also address the coping strategies employed by those with limited English proficiency (LEP). Other panelists recommended examining the distinction between the requirements of a single job and minimum qualifications that might be established by employers to facilitate lateral transfer between jobs within the organization.

The panelists recommended a data collection process based upon a job task analysis, which would incorporate an interview component. This would enable site data collectors to question workers about the cognitive processes they used to complete a literacy task that might not be immediately obvious to the observer. The panelists also suggested collecting data in more depth on fewer jobs than originally planned. Finally, the panel emphasized that the research be intended to collect data only on the literacy requirements of jobs and not on the skills of particular workers.

Panelists recommended that we attempt to relate literacy skills in the workplace to the Young Adult Literacy Simulation Tasks on the National Assessment of Educational Progress (NAEP). This assessment used simulations of real-world literacy tasks to test the literacy skills of 21- to 25- year-olds. Items from the test were placed on a scale that showed the percentage of the test population able to respond correctly to any given item 80 percent of the time. If it were possible to match workplace literacy tasks to items on the test, it would be possible to estimate the percentage in this population able to function at each of the jobs studied. Matching the literacy skills of the study to the NAEP simulation data would provide more credibility to the study than a simple measure of readability. Further, the form in which the data could be reported would be more meaningful than grade level equivalents.

Development of a Research Protocol

We used a literacy task analysis approach to draft a protocol for collecting work-site data. The first section of the protocol detailed the steps to be taken to secure the cooperation of the work site, obtain salient information on its organization, learn about the work site, and plan and schedule the work of the field observers. Subsequent sections provided directions for three site visits by the field observer and for documentation of each visit, including a focus group with those observed or interviewed to confirm or modify the observer's initial literacy task analysis.

The format for the observation of entry-level workers borrowed significantly from the work of Drew and Mikulecky (1988) in two respects. First, because work sites differ in their organization, it was inappropriate to design a protocol that would be followed mechanically either by the person responsible for soliciting the cooperation of the site or by the field observers assigned to the site. Instead, the protocol listed the questions to be addressed at each stage, including those for union representatives if any of the jobs to be observed are unionized. However, the order in which the questions were to be asked and the designations of those from whom information or permission was to be secured were not specified.

Secondly, the protocol specified three options for collecting data on the literacy skills required of each job studied. The first and optimum technique consisted of documenting each task, describing each literacy task in detail, and asking the worker being observed for a commentary on each task (and particularly those requiring literacy skills) while the observation was in process. A second option was employed when the workplace was so noisy or hazardous that it was impossible to ask questions on the spot. In this instance, the observer documented the tasks comprising the job as it was performed and then interviewed the worker at a quieter or less hazardous location. Questions were asked about each task observed to confirm or modify hypotheses about the nature of the literacy and cognitive skills employed on the job. A third option was appropriate for more complex jobs and for jobs performed in hazardous or noisy work areas that required the integrated use of several print materials. This situation entailed the observer studying the job for a shorter period of time to become familiar with its basic components, and then spending a longer time interviewing the worker. In the course of this study, the first option was used most often. Only a few situations required the use of the third.

We piloted an initial draft of the protocol at a manufacturing concern located near us. Modifications to the protocol were made based on the results of the pilot. The protocol was then submitted for expert review before being used for formal data collection. Our field trial revealed little need to modify the protocol, although the organizational structure at each site did mandate modification of the sequence for: obtaining cooperation at the site, obtaining information about hiring procedures and requirements, and procuring copies of documents which workers were expected to be able to read.

Job Category Selection

The expert panel provided little direct guidance on the selection of job categories but did recommend avoiding food service workers and bank tellers, and suggested seeking a balance between female and male dominated jobs. It became obvious that maintenance workers should not be studied because a companion project funded by the U.S. Department of Labor intended to address jobs in this cluster. The clusters ultimately selected because of their position on the U.S. Department of Labor's priority list and because they were likely to provide contrasting work conditions were health and human services and light manufacturing.

It was determined through consultation with the Department of Labor that the jobs selected within these categories should:

- not require prior certification for employment;
- include a position that required a relatively high level of education, defined as more than a high school education; and
- include a position that required a relatively low level of education, defined as a high school diploma or less.

The two job titles selected within health and human services were hospital laboratory assistant and dietary aide. These positions met the requirements above, provided information on a job related to both the health and the service industry, and minimized the time required to recruit sites at which entry-level workers could be observed. Both occupations had a high concentration of female workers.

The jobs selected in light manufacturing did not have the same titles at each plant, but were all similar, entry-level jobs and performed by assembly-line workers. Although assembly-line positions have traditionally been male-dominated, at least half of the workers observed at our sites were women. Observations were conducted in plants in northern Massachusetts and southern New Hampshire that manufactured interior parts for the automobile industry: carpets, instrument panels, and glass window run channels. We felt that the inclusion of an automotive plant was valuable because as the automobile manufacturing industry modifies its technology and the organization of its work, the same expectations are placed on plants supplying automobile components. Consequently, the pressure for change in this branch of light manufacturing mirrors much of industry throughout the nation.

Site Selection

The implementation plan developed subsequently to the expert panel meeting called for observation of two jobs at three sites per industry, with a replication of the study at a single site on the West Coast. Three manufacturing sites and two hospital sites were selected in the Northeast, with a third hospital site located on the West Coast. This configuration yielded data on similar jobs at three different sites in each job category, providing an opportunity for comparison of literacy requirements across sites. Further, because of differences in job definitions at different sites, observations were conducted for a total of four manufacturing jobs and three hospital jobs.

Of the three sites selected for the study of health-related occupations, one was a large urban hospital, one a medium-sized urban hospital, and the third a small county hospital employing a culturally mixed staff. The first of the light manufacturing sites was a family-owned business. Quality control was exercised centrally, and in general, the business was organized in traditional fashion. A second light manufacturing company was a family-owned concern recently bought out by a multinational corporation where management was beginning to introduce its employees to quality circles and statistical process control. The third light manufacturing company was much further advanced in converting its workforce to both of those new concepts. At this site, production line workers functioned as team members and rotated among many work stations. Each worker was required to demonstrate annually his or her ability to perform to a set performance standard in order to maintain certification required of a core operator.

Only one of the hospitals was widely unionized, but neither of the jobs observed in that hospital was union organized. One of the manufacturing plants was unionized, and workers at one of the jobs observed at that site were union members.

Recruitment of sites was not difficult but proved time consuming. The U.S. Department of Labor provided us with a letter of introduction to be used with both management and those workers who would be observed. This, together with personal contacts with plant management staff, facilitated access. Those sites contacted were quite willing to participate in the study and appeared genuinely interested in the questions addressed by it. Yet their priorities were production or service, not research. Thus, it took substantial contact to interest them in the study and to finalize arrangements for data collection.

Although the staff at two of the sites was culturally diverse, it was not within the scope of the study to examine specifically the techniques limited English proficient (LEP) workers used to accommodate to the workplace. A study of sites where there are high concentrations of LEP workers might yield useful insights into the ways in which literacy requirements can be adapted to the skills of this work force, but this question was not a focus of this study.

Data Collection

All four staff members assigned to the workplace literacy project acted as field observers. A one day initial training session for all project members consisted of:

- an overview of the protocol for conducting work site observations;
- observation of an RMC Research clerical staff member performing a specific job task and a debriefing on those observations;
- a site visit during which all observers documented the activities of two production-line workers and jointly interviewed a personnel manager; and
- a review session during which the data collected from the site was compared and discussed.

A meeting to check on training was conducted after the first site observation had been completed, during which field observers again met to discuss the protocol, the amount of time necessary to spend on each job, and the conduct of the focus group. The meeting also was used by observers to assess their ability to document literacy tasks in detail.

Data collection was generally scheduled over three days. Although three complete days were not required for the data collection itself, this schedule provided time for field observers to adjust the amount of time they actually spent observing each job according to the nature of the job. Some jobs could be observed in a single session; other jobs needed multiple observations because workers completed certain tasks only on specific days. For instance, a laboratory assistant visited clinics outside the hospital one day a week, and production-line workers participated in team meetings only once a week. The shortest time allocated to a single worker was approximately two consecutive hours, while the longest time was eight hours. In this latter case, some of the job was described to the field observer who had observed enough of the tasks involved in the job to understand the terminology and requirements of tasks not seen.

The period between observations enabled field observers to construct, and subsequently improve upon, job task analyses and literacy task descriptions as they collected data. This time period provided opportunities for obtaining copies of forms, charts, and other work-related materials which workers used on the job. Wherever possible, copies of forms filled in by the worker were obtained. Confidential information on the documents was obscured during the copying process. These steps facilitated the creation of a preliminary report that could be handed to employees and discussed in detail at the final focus group meeting. The format for the description of each job and literacy task was modified subsequent to the first round of data collection. An example of the final format is included at Attachment D, p. 94.

The three-day time span allowed observers to document other literacy-related materials at the site. Some sites, particularly those in manufacturing, were somewhat suspicious of a camera, and it proved easier to obtain the data through less intrusive techniques. Field observers were able to collect copies of written materials or, if necessary, copied them down at slack times during the three days on site.

The way the same job was broken down or defined varied from site to site. In each instance, the field observer, in consultation with the project director, selected for detailed study those entry-level positions that appeared to have the most demanding workplace literacy requirements. The following table represents the configuration of the jobs studied:

TABLE 1: NUMBER OF WORKERS OBSERVED BY JOB AND SITE

	Manufacturing	A			B			C		
	Total	E	I	P	E	I	P	E	I	P
Assembler	3	1	1	1	-	-	-	-	-	-
Packer	6	1	1	1	1	1	1	-	-	-
Tender/Helper	3	-	-	-	1	1	1	-	-	-
Core Operator	10	-	-	-	-	-	-	6	2	2
TOTAL	22									

	Hospital	A			B			C		
	Total	E	I	P	E	I	P	E	I	P
Nutrition Assistant	8	2	1	1	-	-	-	2	1	1
Dietary Aide	10	-	-	-	3	1	1	3	1	1
Lab Assistant	11	3	1	1	3	0	0	3	0	0
TOTAL	29									

E = experienced worker I = inexperienced worker P = promoted worker

Procedures for Data Analysis

The object of the data analysis was to match literacy tasks observed on the jobs to items on the NAEP Assessment of the Literacy Skills of Young Adults. It proved impossible to gain access to the NAEP items before the data analysis was required to take place. Yet the developers of the NAEP had employed several constructs as guideposts for the creation of simulation items for the test, and then tested these constructs in their analysis of the NAEP scores. The developers also included selected items in a technical report as examples of the types of questions on which respondents had been tested. Consequently, it was possible to formulate a procedure for arriving at a preliminary estimate of the match between NAEP items and workplace literacy tasks using information from the final project report on the assessment (Kirsch and Jungeblut, 1986).

Using this procedure, the data analysis consisted of the following steps:

1. Describe each literacy task in enough detail to permit analysis of the task using the specified procedures.
2. Match each literacy task to the appropriate cell in a matrix of the adult literacy tasks from which NAEP test items were selected.
3. Select the correct scale against which to match the job literacy task. These scales included a prose comprehension scale, a document literacy scale, a quantitative literacy scale, and an oral language scale.
4. Use the Procedures for Rating Workplace Literacy Tasks to determine the approximate position of each task and its literacy scale. (See p. 113.)
5. Select those ranked as the most difficult literacy tasks on each scale and review their position on the scale. In many instances, more than one task was determined to fall at approximately the same point on the scale.

The most tedious and time consuming component of the project consisted of writing up data in a consistent form and in enough detail to permit adequate analysis of the literacy tasks required of each job. The format proposed in the initial protocol for conducting observations proved inadequate because it did not provide enough detail for those who had not observed the job to perform the necessary data analysis. The format was therefore modified as shown in Attachment D of the protocol, p. 94.

We decided to attempt to match the job literacy tasks to the scales developed based on NAEP constructs, and quickly found the analysis itself required training in the conceptual framework of NAEP literacy scales and scores. All project staff were trained in data analysis in a single half-day session, and were asked to analyze the literacy tasks of selected jobs. A subsequent meeting to review the results of the initial analysis revealed low initial inter-rater agreement and the need to further clarify a number of definitions described in the procedures for analysis.

Refined definitions and further training served as the basis for comprehensive data analysis. Each field observer analyzed the data he or she had collected and selected the most difficult literacy tasks on each scale. These tasks were then rated by every field observer to determine inter-rater reliability. Although a higher inter-rater agreement emerged, it was not until a second round of training had occurred that more consistent agreement amongst observers was achieved.

As a further check, the procedures for analysis together with the most difficult literacy tasks for several jobs were submitted to two workplace literacy experts, Mikulecky and Diehl, for review. They were asked to rate a sample of the tasks observed, to assess whether they were able to arrive at ratings similar to those of the project staff, and to assess the legitimacy and clarity of the procedures for analyzing data from the workplace. Several minor modifications were made to scales as a result of comments from these experts before we conducted a formal assessment of inter-rater agreement. (See page 129.)

III. REVIEW OF THE LITERATURE: RESEARCH IN WORKPLACE LITERACY

This literature review was carried out during the course of the Study of the Level of Literacy Required in Specific Occupations for the purpose of gaining background information on the problem of literacy in the workplace and surveying the results of past efforts in workplace literacy. These results guided the current study to investigate the usefulness of readability analysis and job task analyses as techniques for assessing job literacy requirements. Other literacy skills, such as computation, writing, listening, and speaking are also examined. A final section of the review discusses program applications for workplace literacy findings.

Background to the Problem

Amidst this nation's dreams of economic prosperity and expansion are sobering reports such as the following:

- An insurance employee reimbursed a policyholder $2,200 instead of the authorized $22.00 for a $100 dental claim and didn't realize the error. (Henry, 1983)
- Mutual of New York estimated that over 70 percent of the insurance company's correspondence must be edited for secretarial errors in spelling, punctuation and grammar and retyped.
- Eighty-five percent of the secretaries in one study could not recognize capitalization errors in a business letter; 51 percent could not distinguish main ideas from details in a company newsletter. (Heinemann, 1974)
- A worker accidentally poisoned a herd of cattle because he could not read the labels on the bags; at the time he thought he was adding a nutritional supplement to their feed basins. (Kozol, 1985)
- One quarter of the naval recruits were unable to read the safety instructions on military equipment which were written at the ninth grade level. One recruit caused $250,000 worth of damage to a sensitive piece of equipment because he couldn't read the repair manual. (Schweicker, 1983)

The cost of illiteracy to the public and private sector is staggering. It is estimated that 12 billion dollars are being spent annually to maintain the welfare system, the prison system and unemployment compensation (Kozol, 1985). It is estimated that 237 billion dollars in unrealized earnings are forfeited by illiterate adults.

The private sector has been forced to invest significant amounts into workplace literacy programs over the last decade in order to maintain its workforce. According to a survey conducted by the Center for Public Resources (1982), 75 percent of the 2,000 company respondents stated that they offered basic skills programs in order to break the cycle of job stagnation, a cycle all too familiar to employers. Entry-level workers eager for advancement but lacking in literacy skills were denied promotions. Trapped in a low-paying, unchallenging job, the frustrated employee began to produce less, exhibited a high rate of absenteeism and eventually left the company, only to repeat the cycle elsewhere.

Workers and employers have historically viewed competency in basic skills differently. Individuals have looked at competency as important to earnings and opportunities on the job. Employers in the past have seen competency as a prerequisite for hiring and as the responsibility of the individual. With today's shrinking labor pools, the demand for labor will create job opportunities for those less skilled, who will be hired even though they have obvious skill deficiencies (ASTD & U.S. Department of Labor, 1988). "American employers will provide training to fill in the skill gaps and help build individual competence in the basics." (ASTD & U.S. Department of Labor, 1988, p. 6)

A. U.S. Department of Labor, Education and Commerce study (1988) predicted that American industry will have to spend as much as $25 billion each year on remedial education. The authors of the study went on to say that the growing "skills deficiencies in the American workforce are costing American business monetarily, through waste, lost productivity, increased remediation costs, reduced product quality, and ultimately a loss in competitiveness." (p. 18) They quoted a New York Times article which stated that a manufacturer in Florida estimated that it could save up to $1.2 million a year if its employees had stronger math and reading skills. The company reported that because some employees had trouble measuring, its level of waste was higher than it should be. Further, worker difficulty in reading blueprints forced the plant to redo orders and pay overtime.

The ASTD and U.S. Department of Labor (1988) report cited above states:

> The company that develops and delivers a product to the marketplace in the least amount of time is able to pass on the savings of the shorter production cycle. This gives the company the edge in (1) offering a less expensive product, (2) capturing initial consumer interest in a product, (3) promoting consumer loyalty, and (4) establishing a niche in the marketplace that gives the product an advantage over similar products that are likely to follow. (p. 1).

The report went on to say that employers knew that good basic skills could mean a shorter production cycle and improved products of higher quality.

The report also discussed the relationship of basic skills to American industry's ability to develop and implement technical change and the effects of strong basic skills on individual opportunity. It and numerous other reports make it clear that America's ability to compete in the world economy is dependent upon the strength of its worker competence.

The U.S. Department of Labor's study (1988) reported that Motorola, Inc. spent 60 percent of its employee training budget on remedial math and reading skills. The company stated that employers like Motorola, "a multi-national manufacturer of electronics products, are 'fighting for survival' because of fierce international competition and a need for a workforce that is literate in basic areas such as reading, writing, and math." (p. 19) The cost to industry and our nation of the skills' deficits of today's and tomorrow's workers is of major concern.

While we found very little information specific to immigrants, as will be seen, their significance to the American workforce would make findings about benefits to industry of a workforce strong in basic skills applicable to this special population as well.

Yet the cost of developing and operating these literacy programs is substantial (Kozol, 1985). Henry (1983) reported that one company launched its basic skills program with a training director, salaried at $15,000. Just ten years later, the company had to budget $250,000 to staff the workplace program with six full-time trainers, 20 part-time trainers and consultants. At one plant alone, Ford Motor Company spent over $160,000 to provide literacy training to more than half of its employees because workers couldn't understand the materials being used in an in-house training program.

Without any support from the federal government, the private sector undoubtedly bears the financial brunt of these workplace programs. In launching the Adult Literacy Initiative in 1983, President Reagan made it clear the literacy crusade was to be fought at the state and local levels and in the workplace. As one Department of Education official put it, "All businesses sooner or later will have to find their way to the Basic Skills literacy table. It's in their best interest to have trained workers." (Kolenbrander, 1987, p. 14) Given the Gramm-Rudman Act and new tax codes, it is unlikely that the federal government will grant tax breaks or offer other corporate incentives (Kolenbrander, 1987). Employers will have to be convinced that there is a significant financial pay-off in initiating and maintaining workplace programs.

Sarmiento (1989, September 28) of AFL/CIO's Human Resource Development Institute pointed out that unions have had a strong role for decades in promoting basic skills and other training programs in the workplace. He stated that collective bargaining provides the structure and framework for genuine partnerships between unions and employers. Sarmiento recommended joint worker educational trusts such as those established at Bethlehem Steel and by Hotel and Restaurant Employee Unions in Boston, New York, and Washington, D.C. as examples of negotiated educational programs to develop and upgrade workers' skills. He gave statistics on the poor record employers have had in investing in worker training, stating that most training has gone to managers and technical elites. According to Sarmiento, only 18 percent of manufacturers provided training to blue collar workers, and only 14 percent of 1500 courses provided by employers served employees other than clerical or management employees. His argument contrasting what joint union-employer efforts have been able to achieve and what employers have been doing on their own in providing workplace basic skills training was supported by the New York Times article, "Help for Workers in a Complex World" (September 6, 1989, p. 1), which stated:

> Outside of government, some of the most aggressive drives for worker literacy come from the trade unions, which are pressing for education benefits for members.

The Changing Workplace

One of the most critical variables in prompting the private sector to sponsor workplace literacy programs is the changing nature of the workforce. Employers will be coping with not only high rates of illiteracy but also with changing demographics and a dramatically different labor market.

As reported in Workforce 2000: Work and Workers for the 21st Century (Hudson Institute, 1988), a significant decline will occur in the number of young adults available to enter the workforce. The Hudson Institute estimated that by the year 2000, less than 40 percent of the workforce will be between the ages of 16-35, a 10 percent drop from 1985. Consequently, the workforce will be comprised of middle-aged workers; 75 percent of the people employed today will be employed in the year 2000 (Berman, 1988). A significant proportion of this older workforce will need retraining by the turn of the century (Choquette, 1988).

In addition, women, minorities, and immigrants will comprise a significantly higher percentage (80 percent) of workers entering the labor market. This shift in the workplace constituency was dramatically captured by the following data (Johnston & Packer, 1988).

This older, more culturally diverse population will face a job market in which 40 percent of the new occupations will be in the professional, managerial and technical arenas and will require a post-secondary education (Johnston & Packer, 1988). In 1987, the U.S. Department of Labor (Howell, 1988) projected that high-tech jobs such as data processing, computer mechanics, computer programmers and analysts, and medical record technicians will experience the most rapid growth.

Indeed, premonitions of a two-tier labor market loomed: at the top, the highly-educated information/service specialists; at the bottom, entry-level service workers (Howell, 1988). Conflicting statistics as to the percentage of these entry-level service jobs were reported. Some speculated that the low-skill jobs will decrease from 40 percent today to 27 percent by the year 2000 (Johnston & Packer, 1988). Others (Hodgkinson, 1983; Howell, 1988) predicted that a significant percentage (60 percent) of workers will be in demand for jobs such as janitors, nurses' aides, sales clerks, cashiers, waitresses, food preparation workers, secretaries and truck drivers. Whatever the percentage, the literacy requirements for these entry-level positions are likely to increase; "jobs that are in the middle of the skill distribution today will be the least-skilled occupations of the future." (U.S. Departments of Education and Labor, 1988, p. 4) Most experts (Choquette, 1988; Deans, 1988; Elfenbein, 1983; Mann, 1983; U.S. Departments of Education and Labor, 1988) predicted that the computer technology which has infiltrated and reorganized nearly every aspect of the work world will continue to demand more advanced literacy skills of its workers.

The Dictionary of Occupational Titles (1981) listed the language and mathematics requirements of each occupation. Of the 20,000 occupations included, some 5,000 required no higher skills than adding two-digit numbers and recognizing 2,500 two- and three-syllable words. But many job applicants (and even incumbents) could not perform those tasks; no occupation listed zero literacy requirements and those occupations with minimal requirements were the shrinking ones (Dictionary of Occupational Titles, 1981, p. 19). In addition to raising the level of job literacy requirements, technological advancements continue to threaten the job security of workers. By 1975, computers at the Prudential Insurance Company had already eliminated level one of the secretarial jobs and had continued to absorb more and more of the lower-level clerical load (Mann, 1983). Whereas it used to take 68 machine operators 16 days to construct a railroad locomotive, it now takes a computerized assembly line one day with no workers on the line. The tragic irony of all this is that as the private sector struggles with a serious labor shortage, the jobless rate may skyrocket (Hodgkinson, 1983).

The handwriting is on the wall: unless employers in collaboration with labor unions and government agencies take immediate action to counteract the wave of plant closings and the increased levels of foreign competition by offering basic skills programs for workers as well as retraining programs for displaced workers, the economic prosperity of this nation will continue to diminish. The creation of programs like those in Massachusetts Worker Assistance Centers (Anderson, 1988), which have been successful at retraining and placing 77 percent of the 10,881 laid-off factory workers at their former salaries in a variety of high-tech and insurance companies, is essential.

Literacy and the Workplace

As the metamorphosis of the American economy from a manufacturing to an information/service labor market reaches its final stage by the year 2000, business and industry will be faced with an unprecedented challenge: transforming an older, more culturally diverse, less well-educated workforce into a vital, productive force.

Heightening the challenge is the fact that researchers have only begun to unravel the dynamics of workplace literacy. The first substantive inquiry into the literacy demands of jobs (in the military) occurred as recently as 1975. Workplace literacy is in its infancy; "research about the relationship of literacy to job performance is sketchy." (Mikulecky and Ehlinger, 1986, p. 43) To set the stage for understanding this most recent research, a synthesis of current, often conflicting data on the state of adult illiteracy will be presented.

The first wave of literacy campaigns in recent years was launched by the late U.S. Commissioner of Education, James Allen (1969), in which he stated that more than a quarter of the population could not read and that these individuals have been denied a right -- a right as fundamental as the right to life, liberty and the pursuit of happiness -- the right to read. The Right-To-Read Effort, an extensive campaign to eliminate illiteracy at every level, was born and with it the struggle to define literacy -- a struggle that continues today.

Up until the 1970's, most definitions of literacy were based on age/grade levels. The Bureau of the Census still assesses literacy by tabulating the number of people over 14 years who have not completed six years of school. The futility of this definition has been demonstrated by Bormuth (1973-74) in his study which showed that only 33 percent of the sixth graders and 65 percent of the twelfth graders were able to perform successfully on a cloze test. "There is no evidence to support the assumption that six years of schooling are sufficient to raise all students' abilities to the point where they can deal competently with ordinary reading tasks." (Bormuth, 1975, p. 62)

Rejection of educational attainment or grade level designations as viable measures of literacy led researchers to emphasize the pragmatic nature of literacy. Harris and associates (1987), with a mandate from the National Reading Council to determine the percentage of Americans lacking the functional or practical reading skills necessary to "survive" in this country, (Kirsch & Guthrie, 1977-78), conducted the first major study to examine adult performance on real world tasks. Survival was measured by the participant's ability to complete various application forms. The results were disconcerting: "34 percent could not complete a simplified Medicare application; 11 percent, a bank loan; 8 percent, a driver's license application; and 3 percent, a welfare application." (Harris, 1987) While serious questions were raised about the research design, Harris' use of real reading tasks set the stage for continued research into the relationship of literacy and everyday functioning. In addition, he is credited with being the first researcher to "represent literacy on a continuum of competencies rather than as a dichotomy." (Kirsch and Guthrie, 1977-78, p. 498) Rather than reporting a single rate of illiteracy, Harris (1987) stratified literacy into three levels: low survival (4.3 million people); questionable survival (7.1 million); marginal survival (18.5 million).

The landmark study on functional literacy, known as the Adult Performance Level (APL) Project, was commissioned by the U.S. Office of Education in the early 1970's. The results of this extensive undertaking continue to be used as the yardstick for measuring illiteracy in this country (Delker, 1983; Kazamek, 1986). Northcutt and his associates (1975) developed a matrix of five general knowledge areas (consumer economics, occupational knowledge, government and law, community resources, and health) deemed essential to successful functioning and seven literacy skills (reading, writing, speaking, listening, problem solving, computation, and interpersonal skills) which intersected with each general knowledge area. Literacy was defined as "the application of a set of skills to a set of general knowledge areas which result from the cultural requirements that are imposed on members of a culture." (Northcutt et al., 1975, pp. 43-44) Using three criteria -- level of education, income, and occupation -- the researchers identified three categories of functioning and reported their now famous findings per category:

- APL 1 -- 23 million people are functionally illiterate (50 percent are Hispanic, 40 percent black and 20 percent white);
- APL 2 -- 40 million adults are marginally literate (functioning but with difficulty); and
- APL 3 -- remainder functioning competently.

In addition, the researchers estimated that 30 percent of unskilled workers are functionally illiterate, compared to 11 percent in professional or managerial positions.

Northcutt (1975) wrote that as a result of two years of research, some crucial conclusions about adult literacy were drawn:

> Literacy is a construct which is meaningful only in a specific cultural context....The person who is literate in one culture may be illiterate in another....The second part of this first conclusion, that literacy is technology-bound, means that any method of assessing adult literacy levels must provide for subsequent redefinition of both the content and levels of literacy....as technology changes, the requirements for literacy change." (pp. 43-44)

Numerous literacy experts (Cervero, 1980; Kazamek, 1986; Kirsch & Guthrie, 1977-78) challenged the findings of Northcutt's study, citing serious methodological problems, not the least of which was the authors' assumption that functional competence was linked to success in adult life as defined by middle-class values of education, income and status.

Kozol (1985) reported that in a recent update, the APL researchers had estimated that 84 million Americans were functioning at the marginal level or below: 30 million unable to meet daily demands of society and another 54 million struggling to do so. More specifically, Kozol states that the APL researchers reported:

- 26 percent were unable to determine whether their paychecks were accurate;
- 44 percent were unable to match their credentials to job specifications explained in help wanted ads;
- 22 percent could not address an envelope properly; and
- 40 percent could not calculate the price of differences on new and used appliances using ads. (p. 9)

While the APL results tend to be viewed as sacrosanct, they do represent only one set of estimates. Other agencies reported entirely different sets of numbers. (Harmon, 1987)

- Bureau of Statistics recently reported that 13 percent of the adult population was estimated to be illiterate (Barnes, 1986);
- U.S. Department of Education projected 23 million are functionally illiterate and another 23 million are functioning at the marginal level; this is 38 million less than the APL estimate; and
- Office of Vocational and Adult Education placed the illiteracy level at 74 million.

One final report on the nature and extent of the literacy problem facing young adults in this country will be reviewed because of its relevance to workplace literacy and its more optimistic findings. In 1985, the National Assessment of Education Progress (NAEP) assessed the literacy capabilities of 3,600 young adults, ages 21-25. This age group was targeted because it represented the largest proportion of unemployed in the nation (after teenagers). Furthermore, this age group will include a higher proportion of minorities as the total number of young adults drops from 21 million to 17 million over the next ten years.

Cognizant of the complexity and diversity of literacy demands in the home, at school, and at work, the NAEP researchers designed a series of simulation tasks that examined three distinct aspects of literacy:

> - prose literacy -- the knowledge and skills needed to understand and use information from texts that include editorials, news stories, poems and the like;
> - document literacy -- knowledge and skills required to locate and use information contained in job applications or payroll forms, bus schedules, maps, tables, indices and so forth; and
> - quantitative literacy -- the knowledge and skills needed to apply arithmetic operations, either singly or sequentially, that are embedded in print materials, such as balancing a checkbook, figuring out a tip, completing an order form, or determining the amount of interest from a loan advertisement. (Kirsch and Jungeblut, 1986, pp. xiv-xv)

The most striking NAEP finding was that the overwhelming majority (95 percent) of the young adults were competent at the lower levels of each of the three literacy scales noted above. Hence, on document literacy tasks, for example, the participants were able to fill in personal data on job application forms and locate the expiration date on a driver's license.

However, as the simulation tasks increased in complexity (moderate to high) the young adults' literacy performance dropped dramatically, with black youths performing significantly lower than their white counterparts. Only 56 percent were able to follow directions on a mapping activity and interpret a sand-paper chart to locate appropriate grade specifications. Unfortunately, only 9 percent of the participants were able to juggle five variables (day, time, AM/PM, departure, arrival) for the purpose of interpreting a bus schedule. As with all real life tasks in previous studies, the nagging question of the role of experience comes into play. The ability to read a bus schedule may be more a function of experience than literacy. If one has never had the opportunity or need to decode a bus schedule, difficulty is likely to be encountered regardless of one's literacy abilities. Researchers need to attend more carefully to the variable of experience.

The finding that this 21- to 25-year-old cohort performed significantly better than in-school 17-year-olds suggested that adults continued to increase their levels of literacy by virtue of daily participation in society and perhaps through additional educational endeavors. The authors estimated that 95 percent of this sample population read at the fourth grade level, 80 percent at the eighth grade level, and 60 percent at the eleventh grade level.

The NAEP authors concluded that "illiteracy is not a major problem for the population of 21- to 25-year-olders. It is clear, however, that literacy is a major problem." (Kirsch, 1986, p. xvi) This population, while not illiterate, struggled with literacy tasks that required higher levels of information processing. These more complex skills -- the ability to reason, evaluate, problem-solve and so forth -- are the very skills needed to function effectively in the workplace. Estimates are that over 80 percent of job-related reading tasks tap skills at the inferential and critical levels (Mikulecky, 1984). Workplace programs will have to develop intervention strategies to meet this need.

Historically, employers have tried to estimate job-related literacy demands by conducting general job analyses or relying on indices such as the Occupational Outlook Handbook (U.S. Department of Labor, 1978-79). These efforts, however, have been of limited value because the information (i.e., literacy requirements listed in terms of high school/GED diplomas, in-house trainings, etc.) garnered was often too general or arbitrary to be useful. In addition, the job descriptions were rarely derived from an in-depth analysis of actual job tasks (Chang, 1987; Mikulecky & Diehl, 1980). It was not until Sticht (1975, 1987) began to probe the relationship of literacy and its connection with job performance in military occupations that a new direction for occupational literacy was charted.

With the advent of the Vietnam War, the Department of Defense was forced to drop its policy of nonacceptance of lower aptitude applicants. In order to advance the literacy skills of enlistees, the Department launched Project 10,000 under the direction of Sticht and his colleagues at Human Resources Research Organization.

Mindful of the earlier failures of traditional remedial training programs to impact positively on job performance, Sticht (1975) set out to determine the actual literacy demands of military jobs (87 percent of which were compatible with civilian jobs)including the readability levels of military texts. Based on his findings, he designed a training program that would teach job-related literacy skills using the actual job materials.

Sticht found that six weeks of focused job-reading training resulted in a two-year increase specific to job-reading skills; improvement was retained over a three-month period. He reported that "personnel retained 80 percent of the end-of-course gains in job literacy training but only 40 percent of their end-of-year gains in general reading." (Sticht, 1982) He strongly advocated the use of actual job materials during the training sessions. Other significant contributions that Sticht made to occupational literacy include the categorization of job materials into two types (reading-to-do and reading-to-learn) and the discovery that 75 percent of the job-related military material fit the reading-to-do category. The reading-to-do tasks -- primarily fact-finding and following directions -- were highly repetitive in nature.

Recognizing early on that military literacy programs were not generalizable to the general population, Sticht (1975) urged researchers to investigate literacy demands of various occupations. Mikulecky, Sticht's counterpart in the civilian world, extended and refined Sticht's work as well as charting new directions for workplace literacy. In an extensive investigation of 100 occupations (ranging from Vice President to assembly-line worker) in 26 workplaces, Mikulecky and Diehl (1980) interviewed and tested 107 workers on the job in order to determine the literacy demands inherent in this broad range of jobs. They found that 99 percent of the workers did some reading on the job. They spent an average of 113 minutes a day doing job-related reading; hence, a significant proportion of the work day, regardless of the level of the job, involved reading. High level occupations tended to involve more reading but not significantly so.

Furthermore, 56 percent of the participants reported that reading was important to job performance but not vital; 23 percent replied that reading was not important. This finding challenged the accepted notion that literacy demands were becoming increasingly more complex. The researchers made the distinction between literacy demands and literacy availability: it might be that the demands were not increasing but that the opportunities to use print to help carry out a job task were increasing (Mikulecky & Diehl, 1980, p. 224).

Once again, the issue of job eligibility was raised. If literacy demands were not perceived as vital, it was possible that workers of limited literacy abilities were excluded from employment because of inaccurate appraisals of job-related literacy demands. As Harnon (1987) wrote, "Labor market recruiters tend to place greater value on certificates and degrees than on specific abilities and substantive knowledge. Insofar as gaining access to work is concerned, it appears that certification is more significant than literacy." (pp. 33-34) Harmon (1987) cautioned, though, that increased literacy will not automatically result in job mobility. He suggested that there was probably a much stronger correlation between job mobility and economic exigencies than between job mobility and literacy.

Mikulecky and Diehl (1980) speculated that the literacy demands of job related tasks differed substantially from literacy demands of school related/training related tasks. Job related reading tasks were found to be often highly repetitive in nature; 61 percent of the reading tasks were executed on a daily basis. In addition, 63 percent of the tasks were categorized as reading-to-do tasks (as opposed to the reading-to-learn tasks associated with school). A reading-to-do task required the worker to consult a piece of reference material, extract the necessary information and apply it immediately to the job at hand. No real demands were made on short or long-term memory; 40 percent of the workers reported that they didn't learn anything from the reading-to-do tasks as they would reread the same information the next day. In 1982, Mikulecky found that indeed students spent significantly more time engaging in reading-to-learn tasks than workers did. In addition, workers encountered a much greater variety of print materials than did students, and demonstrated a higher level of comprehension of these materials. Significantly more workers also perceived that reading was important to job success than did the high school population. In short, workers faced substantially different literacy demands in the workplace, literacy demands for which the schools had not prepared them.

Mikulecky and colleagues' recent research efforts (1983, 1986) probed the literacy demands of single occupations and resulted in provocative findings. Their research has catapulted workplace literacy out of the basic skills arena and into the realm of cognitive processing.

In an attempt to ascertain the relationship between literacy abilities and on-the-job performance, Mikulecky and Ehlinger (1986), attempting to replicate an earlier study conducted with nurses (Mikulecky & Winchester, 1983), collected data on the literacy abilities, job literacy demands and job performance ratings of 29 electronic technicians. The technicians represented three levels of employment: trainees, experienced workers, and supervisors. The researchers found that while no significant differences in reading abilities existed among the three employment groups, the top job performers at each level of employment exhibited greater levels of metacognitive awareness than did average job performers. Thus, superior workers at the trainee, experienced, and supervisory levels outscored their average peers on their understanding of the uses and powers of literacy and their ability to regulate the literacy processes. These top performers were "able to rapidly determine purposes, identify contradictions and, lacking information, use references and other workers to gather that information. The vast majority (71 percent) of superior technicians reported using literacy to help them solve problems and make decisions. Only 21 percent of the adequate technicians reported this." (Mikulecky and Ehlinger, 1986, p. 61) Thus, for this sample of advanced readers (mean reading level: grade 12+), metacognitive strategies correlated significantly with job performance.

Another "single occupation" study reported interesting results with regard to basic skills and metacognition. Heinemann (1979) audited the literacy abilities of 30 secretaries, each performing satisfactorily according to their supervisors. (No data was collected on their reading abilities, only that each secretary had at least a high school diploma.) The literacy tasks used in the study were designed on the basis of a literature review and interviews with supervisors, a procedure not advocated by most experts (actual observation of the job tasks was usually recommended). Heinemann (1979) found that the secretaries experienced difficulties at both the basic skill level (i.e., capitalization, spelling, use of verb tense, following directions) and the metacognitive level (i.e., judging the significance of business-related events and distinguishing main ideas from details). Heinemann (1979) urged employers to offer seminars that covered both the basic skill aspects of literacy and the higher level metacognitive aspects.

The findings of Mikulecky and Heinemann corroborated the findings of employer surveys. Employers recognized that the literacy demands of the job far exceed the basic skills of reading, writing and computing. A literate employee was also one who could reason and problem solve, as well as cultivate the work ethic with the attributes of self-discipline, responsibility, and respect for fellow workers (U.S. Department of Labor and Education, 1988).

Mikulecky and Echlinger (1986) offered a succint synthesis of workplace literacy research:

- literacy is called for in most jobs;
- workplace literacy differs from school literacy in that workplaces require the use of a variety of materials while schools do not;
- literacy in the workplace is repetitive and usually for the purpose of accomplishing a task;
- workplace literacy is a social phenomenon that includes asking questions and gathering information from other workers;
- workers tend to read job material with higher levels of proficiency than they do general material;
- training for a job usually is more demanding in terms of literacy than is performing the job; and
- workplace literacy is multi-modal in nature (rarely are reading, writing and speaking found in isolation) (p. 43).

Determining Job Literacy Requirements Through Readability Formulas

In order to develop strategies to train adults for the literacy skills needed in the workplace hiring requirements for jobs, employers need accurate assessments of job reading requirements. One method used by employers and researchers has been to estimate the reading difficulty (readability level) of workplace reading materials. The usefulness of this method must be examined through a careful review of what is known about readability formulas.

For over fifty years, researchers have been examining readability as a construct. Definitions of readability (Chall, 1948; Danielson, 1987) ranged from legibility and ease of reading to compelling nature/interest and ease of understanding. While techniques were developed to measure each of these constructs, research activity centered on the exploration of ease of understanding/comprehensibility and resulted in the construction of readability formulas for the express purpose of matching the reader and the text.

Early researchers in the area of readability research approached the task of determining the readability of material by investigating numerous linguistic variables thought to contribute to text difficulty. Two key variables - word difficulty and sentence difficulty - were found by Dale and Chall to account for a large portion of the variance in readability. To the exclusion of nearly all other variables, these two indices were statistically manipulated and transformed into readability formulas by reading researchers such as: Dale and Chall, 1948; Dolch, 1948; Flesch, 1954; Gunning, 1952; and Lorge, 1944. Recent formulas, including those developed by Fry (1968), McLaughlin (1969), and Spache (1978), demonstrate that word difficulty as measured by word length or vocabulary lists, and sentence difficulty as measured by sentence length continue to prevail as leading predictors of readability today.

While the appeal of readability formulas to teachers, writers and publishers is evident, their popularity is no longer restricted to the educational arena. Employers in business and industry have increasingly sought out the aid of readability formulas to help counter the deluge of complaints from the public about incomprehensible documents such as insurance policies, income tax forms, rental agreements and so on. Demands for readable documents have led many states to mandate that readability ratings be established for such documents; Massachusetts, for example, employs the Flesch Reading Ease Scale to calculate the readability of insurance forms (Redish, 1979).

The readability of external public documents represents only one sphere of interest for employers. Documents internal to the workplace such as manuals, forms, policy statements, and memoranda have recently come under scrutiny. Research in workplace literacy (Mikulecky and Diehl, 1980) has indicated that 99 percent of workers in both high and low level occupations spend an average of two hours a day reading job-related materials. The comprehensibility of job-related materials is clearly related to worker productivity.

Complicating matters even further is the changing profile of the American worker. No longer will employers be recruiting young, educated, culturally homogeneous adults. By the year 2000, employers will face the challenge of transforming older, more culturally diverse, and educationally unprepared men and women into a productive workforce. Workplace materials will have to accommodate a wide range of reading abilities. Since workplace literacy is still in its infancy, a great deal of research is needed to address the complex issue of what makes job-related materials readable.

Not surprisingly, reliance on traditional readability formulas for tackling the issue of text difficulty of adult materials has been advocated by many experts. Taylor and Whalstrom (1986) recommended the use of the following formulas: Dale-Chall Formula (Dale and Chall, 1948), the Fry Readability Graph (Fry, 1986), the Fog Index (Gunning, 1952), and the Flesch Formula (Flesch, 1943). Laubach, founder of one of the largest adult literacy volunteer organizations, Laubach Literacy Action, has recommended the use of the Fog Index and the Fry Readability Graph for determining the readability level of adult materials. In fact, readability formulas have been applied to job-related materials. In one major study on occupational literacy, Rush, Moe and Storlie (1986) used the Dale-Chall Readability formula and the Fry Readability Graph to determine the readability of job-related materials for 10 occupations.

Sticht (1975), in his groundbreaking investigation of literacy demands in military occupations, was the first to question the validity of applying traditional formulas to job-related materials. Sticht noted that nearly all the existing formulas were developed for use with a school age population, and expressed reservations about using the same indices for adult, job-related materials. He speculated that since workplace material contains a great deal of specialized vocabulary, it is likely that the existing readability formulas would, in general, overestimate the reading difficulty of the material. In other words, technical vocabulary is not necessarily difficult for an experienced worker. Davison (1985) also noted that the predictive power of readability formulas decreased substantially when applied to specific materials because "the statistical strength of the formulas lies in the large aggregates of different texts and different levels of abilities." (p. 19)

Concerned about the limitations of the existing readability formulas, Sticht and his associates developed the FORCAST Readability Formula for use with job-related materials. Development of FORCAST entailed a number of steps: selection of passages from actual job materials; assessment of 15 text variables occurring in each passage; assessment of the adults' comprehension of each passage by means of a cloze test; and determination of subjects' reading levels via standardized tests.

Of all the text variables showing a high correlation with the cloze test, Sticht et al. (1975) chose one syllable words for their readability index. Simplicity of use was also a major factor in the selection of this variable. The resulting formula:

$$\text{FORCAST Reading Grade Level} = 20 - \frac{\text{number of one-syllable words}}{10}$$

yielded a high correlation (r = .90+) with the Dale-Chall and Flesch formulas. Sticht (1975) alerted readers to two key limitations of FORCAST: (1) the formula's applicability was restricted to job-related materials used by adults; (2) it was unable to predict the readability of materials below a fifth grade or above a twelfth grade level.

Researchers interested in establishing the literacy requirements of job-related materials are increasingly employing the FORCAST Readability Formula (Diehl and Mikulecky, 1980; Mikulecky, 1982). Given its widely accepted usage, FORCAST seems the most useful formula for estimating the difficulty level of prose literacy materials in the workplace.

Yet, strong criticisms have been levied at the exclusive use of readability formulas in determining text difficulty. The inability of readability formulas to capture even the controlled variables of word and sentence difficulty is all too clearly demonstrated by studies that pit one readability formula against another. In numerous studies conducted by Armbruster, Osborn and Brown (1965), Guidry and Knight (1976), Walker (1966), and Fuch et al. (1983), researchers have applied various readability formulas to the same passage only to find diverse readability scores assigned. In one study, the Spache Readability formula estimated a third grade level for a particular passage, while the Fry Readability Graph estimated a seventh grade level for the same passage (Fuch et al., 1983).

Not surprisingly, the readability formulas developed specifically for use with job-related materials are subject to the same criticism. Rubin (1985) cited a 1980 study by Kern who, at the request of the Army, investigated the ability of two readability formulas designed specifically for military job materials to predict comprehension levels. Kern applied FORCAST to the experimental passages Kincaid used in creating his readability formula, and vice versa. Kern found major discrepancies between the grade level estimates; FORCAST estimated the grade level difficulty of Kincaid's passage as ranging between 14 and 21 while Kincaid's estimates ranged from 11 to 12.

Such variant readability scores result in part from the utilization of slightly differing text variables (i.e. counting number of letters in a word versus counting the number of syllables) or from different weights given to various variables.

Problematic also are the underlying assumptions associated with the two popular text variables - word difficulty and sentence difficulty. The assumption that one syllable words are easy to read is unsubstantiated (Danielson, 1987; Diehl and Mikulecky, 1981). For example, Fry (1986) cited Perera (1980) who established that the simple word TOY will cause comprehension problems for children when it is used as a verb. Likewise, assumptions about sentence difficulty - that short sentences are easier to process than long ones - have proven erroneous (Fry, 1986).

The fallibility of readability formulas has also been demonstrated by researchers who have manipulated various text variables to improve the reader's comprehension while maintaining the same readability levels for the original and revised passages. For example, investigators revised a set of complex instructions for jurors to increase comprehensibility; they adjusted the distance between pronouns and their referents, eliminated double negatives and so on, without affecting the readability estimate of the original set of instructions. The authors found that the jurors had better comprehension of the revised instructions. The key fact was that the formulas were unable to detect the text changes.

To bring into focus the criticisms about the inability of readability formulas to capture the amorphous nature of readability, two major categories of limitations will be explored: (1) the readability formulas' failure to take into account other essential text variables known to affect comprehension; and (2) the formulas' disregard of the significant role of the reader in the determination of a text's readability (Fry, 1986).

As mentioned earlier, readability formulas have traditionally relied on the predictive powers of two text variables: word difficulty and sentence difficulty. Readability formulas using these two variables correlated well (r = .7 to .8) with other independent measures of comprehension. Researchers' attempts to increase these correlations by incorporating other text variables such as syntax proved futile (Rubin, 1985). In addition, a high premium was placed on finding the formula that obtained "the highest degree of prediction using the least number of factors" (West, 1974, p. 29) to ensure easy use.

Over the last two decades, however, much research has been accumulated to verify that factors other than word and sentence difficulty impact on the readability of written discourse. A recent analysis of 36 readability studies revealed that only 19 studies found a significant relationship between comprehension and readability scores (Klare, 1976). The following is a brief synopsis of recent research into text variables, based on a review of the subject by Allen (1985) that impacted significantly on comprehension but were not accounted for by formulas:

- **Concept load** - Concept definitions must be expressed not only in comprehensible terms but also with concrete examples if the reader is to fully grasp the density of ideas associated with that concept.
- **Connectives** - Inclusion of connectives (words like BECAUSE, ALTHOUGH, BUT, THEN) increases the comprehensibility of the text. Contrary to the time-honored belief that long sentences are more difficult than short ones, Pearson (1974-75) demonstrated that lengthening sentences with the inclusion of connectives actually increases comprehension of the passage.
- **Text Organization** - The organizational scheme of written material has been shown to affect the reader's understanding of the text. Meyer and Freedler (1980) presented students with two sets of passages that contained the same content but were structurally different. The researchers demonstrated that passage structure impacts significantly on comprehension.
- **Inferences** - The number and complexity of inferences to be made by the reader during the processing of textual material affects understandability (Rubin, 1985).
- **Cohesion** - The higher the degree of cohesiveness in textual material, the greater the comprehension. Clark (1981) has suggested that one way to establish the cohesiveness of a text is to analyze phrases in a text to determine the distance between pronouns and their referents and to analyze the use of explicit connectives (BECAUSE, AND, BUT).

In view of current theories about the reading process, readability formulas are considered anachronistic by many experts because they are insensitive to the dynamic interaction of the reader and the text. As Rosenblatt (1978) wrote: "A text, once it leaves its author's hands, is simply paper and ink until a reader evokes from it a literary work." (p. ix) It is only by examining the reader in relation to the text that true readability can be rendered.

Existing readability formulas are unable to examine the reader-text interaction. The text-bound formulas totally neglect the following reader characteristics:

- **Prior knowledge** - Researchers (cited in Anderson and Davis, 1986) investigating schema theory have demonstrated the dramatic role that prior knowledge plays in the comprehension of text. In a study of the impact of schemata (the "packet" of previous knowledge that the reader brings to the text) on comprehension, Anderson presented an intentionally ambiguous passage to two groups of college students. The physical education majors understood the passage to be about card playing while the group of music majors reported the same passage to be about a musical event.

- **Motivation** - The degree of motivation with which the reader approaches the text impacts significantly on readability. Fass and Schumacker (cited in Allen, 1985) found that the scores of students who were rewarded with money for reading passages scored significantly better than students of the same ability who received no monetary reward.

- **Interest** - While research on the effect of interest on comprehension is inconclusive, two studies have shown that interest can enable a student to comprehend materials at levels higher than his/her instructional level. (Redish, 1979)

While readability formulas have come under strong attack by researchers, viable alternatives for measuring text difficulty are still in an embryonic state.

Perhaps the most widely accepted alternative to traditional formulas is Bormuth's cloze procedure (Redish, 1979). Central to the effectiveness of this readability approach is the direct involvement of the reader with the text. The reader is given a series of passages in which every fifth word is deleted. The reader's ability to fill in the blanks is directly related to his/her ability to comprehend the material. The percentage of correct responses indicates whether the passages read are at the reader's independent, instructional or frustration level. However, the irony of this effective readability alternative is that, since it requires reader involvement, its usefulness to educators/publishers is immediately diminished. Extensive and expensive field-testing on the part of publishers would be required, for example, to establish readability ratings for their textbooks.

All of the protest around readability formulas has served to revive support for teacher judgement as a valid alternative for predicting readability. As early as 1948, Dale and Chall found a high correlation (r = .9) between teacher judgement of text difficulty and the Dale-Chall Readability formula (Redish, 1979). Although other studies have reported mixed results (Klare, 1984) about the reliability of teacher judgement, educated guesses and teachers' intuitions have been capitalized on by some researchers. Two readability techniques, the SEER (Singer Eyeball Estimate of Readability, developed by Singer in 1975) and the Rauding Scale (created by Carver in 1975-6) instructed teachers/publishers to rate passages subjectively by comparing them to a set of graded passages (Redish, 1979).

The Readability Checklist, authored by Irwin and Davis in 1980 (Allen, 1985), provided yet another judgement based alternative for text analysis. Cognizant of current reading research, Irwin and Davis developed a checklist that facilitates the analysis of factors affecting the understandability and learnability of textbooks. Teachers are asked to rate the textbook (on a 1-5 scale) on text-based factors such as organization, concept load, syntax, clearly stated main ideas and so on. Reader-based factors such as prior knowledge, experience, interest, and motivation are also rated.

Lastly, and of particular interest to the current study, is an alternative readability strategy proposed by Chall (1976, 1983), Chall's Reading Stages - A Measure of Reader Maturity Required by the Reading Matter. Central to the discussion of this strategy is an understanding of Chall's stages of reading development. Chall formulated a stage theory or scheme for describing the stages through which individuals progress in their journey from non-reader to mature, highly proficient reader. Chall's stages attempt to capture the qualitative changes that occur as a reader experiences each stage and makes the transition to the next.

A key supposition underlying the stage theory is that, as the textual material encountered by the reader increases in complexity and abstraction, so do the cognitive demands. Specifically, those cognitive demands can be tapped by determining whether the text requires the reader to:

- have internalized the alphabetic principle (Stage 1);
- confirm what is already known without acquiring new information (Stage 2);
- activate prior knowledge and experience to facilitate the learning of new information; text must be "clear, within one viewpoint and limited in technical complexities" (p. 20), (Stage 3);
- process a multiplicity of viewpoints and demonstrate a greater depth of understanding (Stage 4); and
- construct knowledge on a high level of abstraction and generality and create one's own 'truth' from the 'truths' of others (p. 24), (Stage 5).

Chall has proposed that difficulty of material can be gauged by reading a passage/text and assigning a reading stage level in accordance with the level of cognitive processing needed to understand the text. Chall and her associates (Chall, 1984) and others have employed stage theory to determine the difficulty levels of various texts. In a study to investigate the complexity of passages used in eight minimal competency reading tests, Chall, Greeman and Levy (Chall, 1984) applied the Dale-Chall Readability formula and the Reading Stages to the same sets of grade 11 test passages. Considerable variability in readability levels of the test passages (grade 5-12) was found. Stage analysis of the same passages revealed a good deal of uniformity. The majority of passages were judged to be at the Stage 3 level, indicating that they were factual in nature with a single viewpoint expressed and characteristic of material found in grades 3-8. The authors noted that none of the passages at the high school level were judged to be at Stage 4, as would be expected, in seven of the eight tests examined.

Applicability of stage theory to the workplace has been posited by Chall (1983): "It would be useful to know what stage of reading various jobs require . . . It would be interesting to relate the number of young adults at different reading stages with the number of jobs requiring these levels of reading development." (pp. 147-148)

Chall's inquiries as to the stage level of job-related materials may have some interesting implications for workplace literacy. While researchers (Mikulecky and Diehl, 1980; Mikulecky and Echlinger, 1986; Rush, Moe and Storlie, 1986) have found relatively little variability in the readability levels of job materials (grade levels range from 10-12), it is possible that job materials assessed at a particular readability level could be processed at stages higher or lower than the readability estimates would suggest. For instance, a job manual written at the 11th grade level may only require Stage 2 processing by an experienced worker who merely consults the manual to locate a familiar piece of information needed to complete a task. Still to be determined, of course, is whether a job can be cataloged at a particular stage or whether the cognitive demands of a particular job shift dramatically. Chall (1983) contended that stage theory is fluid in nature. It is likely that many adults are capable of Stage 5 processing in a particular area of expertise but are functioning at lower levels in other areas of knowledge.

Sticht (in Rothkopf, 1989) cited a 1977 review and critique of methodologies for identifying the literacy requirements of jobs which noted the limitations of reading levels needed for work. Sticht's main argument was that such analyses cannot be applied to figures and tables, which may make up two-thirds of the materials workers read on the job. Furthermore, readability analyses cannot assess the writing task demands of the workplace. As the definition of workplace literacy broadens to take into account other communicative competencies, workplace literacy data collection and analysis techniques must also be broadened.

Literacy Skills Other Than Reading Utilized on the Job

There is support for the inclusion of listening, speaking, reading, writing, and calculating in the operational definition of workplace literacy from business and industry as well as the academic community (Anderson, 1988; Elfenbein, 1983; Henry, 1983; Mikulecky and Diehl, 1980; Mikulecky and Echlinger, 1986; Rush, Moe, and Storlie, 1986; Sticht, 1975, 1977, 1986; Schweicker, 1988).

Employers concur that ". . . many entry-level workers lack minimal competence in reading, mathematics, writing, speaking, listening and problem-solving skills." (Elfenbein, 1983, p. 1) Interestingly, one major survey (Henry, 1983) reported greater concerns on the part of employers with regard to employee deficits in math, speaking, listening and problem solving than in reading. A more recent survey (Anderson, 1988) corroborated Henry's (1983) finding; employers targeted problem solving skills and writing skills as top priorities for job literacy skills programs.

While the thrust of the research in workplace literacy has focused on reading, researchers are increasingly attending to the importance of listening, speaking and writing in the world of work. Sticht (1975) in his investigation of literacy demands of military jobs hypothesized that, in addition to reading, the communication skills of listening, speaking and writing affect job performance and employability. He observed that job tasks were frequently learned by watching and talking, and speculated that listening and speaking skills may be as relevant to job performance as reading. Sticht (1975) indirectly tested this hypothesis by examining the impact of modes of learning (reading vs. listening) on comprehension. While no significant differences were found in recall of factual information via reading or listening, 25 percent of the workers stated a preference for learning by listening.

Increased attention to the role of listening and speaking in the workplace was given by Mikulecky and Diehl (1980) in their job literacy investigation. The researchers reported that 56 percent of the participants believed that reading tasks were important but not vital to completion of job tasks and another 235 reported that reading was not necessary. The workers noted that information needed to complete a job task can often be learned from other sources such as co-workers. This and other findings prompted Mikulecky and Ehlinger (1986) to conclude that "workplace literacy is a social phenomenon which includes asking questions and gathering information from other workers." (p. 43)

Guided by the assumption that worker success is highly associated with the literacy-related competencies of listening, speaking and writing, Rush, Moe and Storlie (1986) examined this broad spectrum of literacy demands for ten occupations. In addition to collecting data on the readability levels, purposes, types and frequency of use of written job materials, the researchers audio-taped and analyzed oral language samples of workers communicating on the job. Samples of written work were also gathered and analyzed. While the authors did not report any empirically based findings concerning the nature and extent of communicative demands in the workplace, they did offer the following observations concerning oral language:

> ■ Except in the secretarial jobs in which formal language was frequently employed, an informal level of usage typified on-the-job oral language.
>
> ■ Much language encountered was social and not directly related to work. When talk was job-related, it focused on specific tasks, tools and equipment.
>
> ■ Clarity of communication was clearly more important than what might be termed good grammar. (p. 18)

Observations concerning the job-related writing were:

- Samples of written language revealed that only rudimentary skills were required. The secretarial occupation stood alone in requiring a formal level of writing.
- Typical handwritten communications were done in concise, ungrammatical, nonstandard English containing only essential information.
- Clarity was the chief requirement of on-the-job writing. (p. 17)

Additionally, Rush et al. (1986) cited Diehl's earlier findings (1980) on types of writing tasks occurring in the workplace: 65 percent of the writing tasks involved completion of simple forms or creation of brief memos. Diehl characterized the writing tasks as simplistic and repetitive.

Undoubtedly, the most comprehensive analysis of the multidimensional nature of literacy was undertaken by Mikulecky and Ehlinger (1986). As part of an exploration on the metacognitive aspects of workplace literacy, the researchers tracked the amount of time 29 electronic technicians engaged in reading, writing, listening and speaking job tasks, in particular focusing on how frequently a worker shifted from one mode of activity (reading, writing, listening or speaking) to another within a one minute time frame. Findings pertinent to this aspect of the study can be summarized as follows:

- Job-related reading time averaged approximately two hours a day.
- Job-related writing constituted an additional half hour of daily activity; interestingly, the average duration of these writing episodes was exceedingly short - less than one minute.
- On average, workers spent a large amount of time (five hours) each day engaging in "multi-modal" activities - shifting from one literacy mode (reading, writing, listening and speaking) to another in order to problem-solve a job task.

For this group of advanced readers, job-related problem solving necessitated a strong interaction of the literacy modes. As a result of this study and others, the metacognitive and communication aspects of literacy are being more widely included in definitions of workplace literacy. Thus, competencies previously looked at in aptitude rather than literacy assessment are finding applicability to research in understanding the nature of literacy. Sticht (in Rothkopf ed., 1989) cited recent work of Olsen (1986) that defined intelligence as "competence with communication and cognitive technologies (including literacy)," p. 80. He also mentioned the observation of Carroll (1987) that at the more demanding levels, the literacy tests of the National Assessment of Educational Progress resembled traditional measures of verbal aptitude. Sticht speculated that such developments may bring the work of industrial psychologists and that of scholars of adult literacy closer together.

For these reasons, it seems valuable to review the job task analysis techniques which have been used to identify the aptitude requirements of jobs. A summary of a few articles from the hundreds written since 1960 will serve to illustrate the kinds of skills studied, the methods used, and the potential usefulness of job task analysis techniques for determining job literacy tasks.

Job Task Analysis Techniques and Their Applicability to Workplace Literacy

The validity and usefulness of job task analysis techniques has been examined in numerous studies. Sticht (in Rothkopf, ed. 1989) pointed out that the work of industrial and human factors psychologists offered insights into the relationships of literacy to productivity at work. Studies have been done of aptitude requirements of various jobs and methods have been developed for using job and task analysis to identify communication and cognitive skill

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requirements of job training programs and the jobs themselves. Sticht reported that this line of research began before 1900, but its methods have not been used by most contemporary researchers in workplace literacy.

A study by Gomez-Mejia, Page and Tornow (1982) compared the relative accuracy and practical utility of seven different job evaluation approaches for determining compensation levels. The study included three statistical methods (i.e. selection, combination, and weighting of variables for the prediction of grade level that were derived from mathematical analysis), three traditional methods (i.e. based primarily on a rational model generally used by compensation specialists, with minimal assistance from statistical item analysis), and a "hybrid" method (i.e., combined elements from both approaches, using a combination of statistical procedures and rational judgment). It was found that traditional and hybrid systems were at least as accurate, reliable, and objective in predicting grade level as were statistical methods. The investigators noted that researchers in the field of job analysis have been concerned primarily with the development of a taxonomy of common dimensions on which jobs may be compared, and have not been as interested in demonstrating the value of these analytic systems for achieving more practical criteria such as accurate grade level classifications. They also noted that respondents perceived many behavioral items (e.g., employee's strengths and weaknesses) included in job analyses as too abstract and ambiguous. They emphasized that a key consideration in assessing the relative value of different job evaluation systems was the extent to which the individuals directly affected by the application of the systems perceived them to be equitable, understandable, and efficient.

Two articles on use of job analysis systems serve to illustrate the dimensions examined. Fleishman (1984) in an address to the International Personnel Management Association Assessment Council offered three potentially useful criteria for classifying human task performance: (1) task dimensions, (2) behavior (response) requirements, and (3) inferred processes. He suggested that tasks could be classified using several different approaches, including: (1) behavior description (e.g., handling objects); (2) behavior requirements (e.g. problem solving); (3) ability requirements (e.g. verbal abilities); and (4) task characteristics (e.g., type of instructions). Fleishman went on to say that classifying tasks in terms of ability requirements would encourage utility in job analysis, test development, setting performance standards, and classifying jobs into "families."

In a second article, Banks et al. (1983) introduced the Job Components Inventory (JCI), a then new technique for performing job analysis. Like established techniques such as the Position Analysis Questionnaire, the JCI used a written questionnaire to analyze job tasks. The JCI looked at five principal components of jobs: (1) use of tools and equipment, ranging from small hand tools to larger pieces of machinery; (2) perceptual and physical requirements such as strength, dexterity, and reaction time; (3) mathematical requirements as sophisticated as elementary algebra and trigonometry; (4) communication requirements such as preparation of reports and letters, dealing with complaints, and receiving written communications; and (5) decision making and responsibility, covering decisions about methods, order of work, standards and related issues. In the study Banks discussed in his article, the JCI appeared to be readily understood by incumbents of jobs requiring limited skill, proved to be easily used by non-specialists, and required about an hour to complete. Results generated occupational components common to a wide range of jobs that could be used as the basis for broad based training or a core curriculum.

Another study investigated narrative job descriptions as potential sources of job analysis ratings. Jones et al. (1982) examined whether narrative job descriptions could be converted to quantitative rating scores using the Position Analysis Questionnaire (PAQ), a traditional job analysis technique cited earlier. The narrative descriptions contained detailed information about the scope of job duties, experience and training requirements, supervisory controls, and general work conditions typically encountered by individuals in specific job categories. Investigators found that the quantitative job ratings derived from the narrative descriptions appeared to be closely linked to measures of required worker abilities. Further, use of narrative descriptions represented a substantial reduction of cost and intrusiveness over similar data acquired by more traditional job analysis techniques. The investigations concluded that organizational researchers would be able to classify positions into meaningful job families and subfamilies based on information presented in widely available narrative job descriptions. They found narrative descriptions to be inappropriate sources of information if a fine level of discrimination between job categories was required. They also cautioned that to be useful, such narrative job descriptions must be accurate.

The reliability of the results of job difficulty ratings was examined in a study by Cain and Green (1983) which attempted to estimate overall levels of reliability for a subset of widely used Dictionary of Occupational Titles (DOT) ratings, as well as to identify significant sources of variation in these ratings. Reliabilities were obtained for the categories of worker functions, training times, physical demands, and working conditions. The actual tasks charted in this study closely approximated tasks performed in the normal course of job analysis for the DOT, although study investigators were unable to observe jobs directly. The study concluded that some caution must be taken in using ratings available from the DOT. Ratings of some of the most commonly used DOT variables (e.g. worker functions in relation to people and data, general educational development and specific vocational preparation) appeared to be highly reliable. The DOT reliabilities were considerably lower for occupations in the service sector. This was considered at least partially a function of the nature of jobs found in this classification.

A study by Mumford et al. (1987) looked at the construct validity of the occupational learning difficulty index, a technique that attempted to measure the difficulty of occupations by aggregating workers' evaluations of task learning time. Occupational learning difficulty was defined by weighting learning time ratings for total time spent in task performance, then aggregating these weighted values across all tasks performed in an occupation. The sample used in the investigation consisted of 48 entry-level occupational specialties drawn from a population of about 200 entry-level specialties that existed in the Air Force. Investigators found that the occupational learning difficulty index yielded an interpretable pattern of relationships with training context and performance variables. They concluded that the task learning time index could prove of some value in designing training, in allocating manpower and in creating job evaluation systems. The authors noted that traditionally, job analysis efforts have tended to focus on comprehensive descriptions of job activities rather than on identifying and assessing specific activity characteristics of value in formulating personnel policy. They stated that it is possible to develop psychologically meaningful constructs and measures useful for summarizing a mass of descriptive data in a manner useful for making personnel decisions and fulfilling specific administrative purposes. They suggested examining other constructs such as discretionary task performance, information acquisition requirements and work load to move toward providing a more sophisticated basis for describing and understanding the relationship between job activity and human performance.

A relatively new and innovative approach to occupational analysis called DACUM (Developing a Curriculum) was documented in detail in a handbook produced by the National Center for Research in Vocational Education (Norton, 1985). The method uses working committees of successful workers and their supervisors, questionnaires, observations, and interviews to identify and document the general job responsibilities and specific job tasks performed on the job and to identify entry-level tasks. A task analysis is then used to determine the specific skills, knowledge and attitudes workers need to perform each task. The resulting information is incorporated into modules, learning guides, and instructional materials for training purposes. While the DACUM process has been used mainly by the National Center for Research in Vocational Education, it has also been used by a number of other educational centers for curriculum development purposes.

The foregoing discussion of job task analysis techniques and their uses serves to point out that in selecting a method for studying the components of jobs one must consider the purpose of the study and the likelihood that the job task analysis technique and constructs studied will provide accurate and useful information. For micro-level uses, observations and worker interview seem to be essential. Sticht (in Rothkopf, 1989) pointed out that the results of such task analyses have been used extensively by government and industry, particularly in developing and using literacy-loaded assessment batteries to determine the literacy levels needed for thousands of jobs in military and civilian contexts and to screen applicants for such jobs.

The study conducted by Mikulecky and Ehlinger (1986) cited earlier used job analysis techniques in a manner particularly useful for assessing job literacy requirements. They observed workers on the job and characterized each subject's on-the-job behavior in terms of: (a) the mode or type of activity, (i.e., reading, writing, doing, listening, and speaking); (b) the time spent in each mode for a total of eight hours spread over three work days; (c) and the purpose for which each activity was undertaken (i.e., to do, to learn, to assess, to reach agreement, to confirm the correctness of an action, to diagnose, to socialize or entertain, and to instruct); (d) the type of materials used in support of the activity (e.g. manuals, schematics, forms); and (e) the strategy or manner in which the materials were used (i.e. read and do, read and rehearse, relate and associate, skim for main idea and detail, skim for an overview, ask questions, focus attention). In addition, researchers conducted structured interviews to allow observers to obtain supplementary data concerning what they had observed and to elicit more detailed information. This methodology, combining observations and interviews of workers, seems particularly useful in conducting workplace literacy studies.

Based on this study, Drew and Mikulecky (1988) developed a handbook for gathering and developing job specific literacy materials for basic skills instruction. This handbook provided a practical method for conducting a literacy task analysis. The authors described whom to talk to, what to look for, how to observe and interview workers, and how to gather the literacy related materials actually used by workers on the job. They suggested that the most useful method of determining what a worker is doing and how he/she is performing an observed task is to ask questions while the task is being performed. If the work environment is not conducive to this, interviews can be carried out in a quieter spot during a work break or at a later time. The purpose of interviews is to determine how workers actually use materials in performing tasks and the nature of the literacy task as performed by the worker. This method, while it has some characteristics of the DACUM process, is simpler and easier to implement and, of course, focuses on collecting job literacy task data and materials. Hence, it seems most appropriate for research in workplace literacy. This conclusion is supported by Sticht, Fox, Hauke and Zapf (1977) in two studies for the Navy in which they cited the use of job task inventories, worker and supervisor interviews and the use of predictive validity studies to relate literacy skills to job proficiency. In a recent study, Sticht (1987) concluded that the purpose of the inquiry must guide the choice of method. For job-related literacy training, he recommended task inventories and interviews. Ethnographic studies of the uses of literacy and cognitive skills in the workplace may also provide useful information for understanding the literacy demands of work and how to most efficiently develop them, according to Sticht (in Rothkopf, 1989).

In addition to literacy requirements, employers are interested in workers who have the personal habits and interpersonal skills to perform effectively on the job. A recent survey of the Greater Boston Chamber of Commerce (Anderson, 1988) revealed that indeed work habits and metacognitive awareness are of utmost concern to employers. Basic skills deemed essential for employees were ranked in order of importance as follows:

1. Job readiness -- punctuality, attitudes, behavior and dress
2. Computer literacy
3. Critical thinking and problem solving skills
4. Basic writing skills
5. Basic reading skills
6. Basic math skills
7. ESL

A recent joint publication of the U.S. Departments of Labor, Education, and Commerce (1988), summarized business workplace needs for entry-level workers with stronger basic skills, and also noted a need for employees with positive attitudes, and with the ability to be flexible, to solve problems, to work independently, to take pride in their work and to "work cooperatively with people of different personalities, race, sex, across different authority levels and organizational divisions." (p. 18) Providing workers with the skills to work cooperatively across such barriers is challenging in any setting, but is particularly so in multicultural settings.

The Employability Skills Task Force (1988) identified three categories of skills that will be required of Michigan workers in the future: academic skills, personal management skills, and teamwork skills. (See Exhibit A, Employability Skills Profile.) Other publications from business and industry identify the need for similar skills. Teamwork skills are being stressed in a variety

EXHIBIT A

EMPLOYABILITY SKILLS PROFILE

Three Categories of skills will be required of Michigan workers in the future:

ACADEMIC SKILLS (Those skills which provide the basic foundation necessary for a person to get, keep, and progress on a job)	**PERSONAL MANAGEMENT SKILLS** (Those skills related to developing the attitudes and behaviors required to get, keep, and progress on a job)	**TEAMWORK SKILLS** (Those skills needed to work with others on a job)
MICHIGAN EMPLOYERS WANT A PERSON WHO CAN: o Understand spoken language and speak in the language in which business is conducted. o Read written materials (including graphs, charts and displays). o Write in the language in which business is conducted. o Understand and solve problems involving basic arithmetic and use the results. o Use the tools and equipment necessary to get a job done. o Access and use specialized knowledge when necessary (e.g., the sciences or skilled trades) to get a job done. o Think and act logically by using the steps of the Scientific Method (i.e., identify problems, collect information, form opinions and draw conclusions).	MICHIGAN EMPLOYERS WANT A PERSON WHO CAN: o Identify personal job-related interests, strengths, options and opportunities. o Demonstrate personal values and ethics in the workplace (e.g., honesty, fairness, and respect for others). o Exercise a sense of responsibility. o Demonstrate self control. o Show pride in one's work. o Be enthusiastic about the work to be done. o Follow written or verbal directions. o Learn new skills and ways of doing things. o Identify and suggest new ideas for getting a job done. o Be a leader or a follower depending upon what is necessary to get a job done.	MICHIGAN EMPLOYERS WANT A PERSON WHO CAN: o Identify with the goals, norms, values, customs and culture of the group. o Communicate with all members of a group. o Show sensitivity to the thoughts and opinions of others in a group. o Use a team approach to identify problems and devise solutions to get a job done. o Exercise "give and take" to achieve group results. o Function in changing work-settings and in changing groups. o Determine when to be a leader or a follower depending upon what is necessary to get a job done. o Show sensitivity to the needs of women and ethnic and racial minorities. o Be loyal to a group.

(Employability Skills Task Force, 1988, p. 5) of occupational settings, particularly those such as the automobile industry where Japanese production models are being studied and emulated.

Such teamwork skills as those listed by the Employability Skills Task Force require new ways of thinking and acting for both traditional American workers and immigrant employees. All of the competencies listed under teamwork skills present challenges for workers, particularly in multicultural settings. Training in group process, appropriate to mainstream Americans, is likely to be confusing to immigrant employees unless the cross-cultural issues involved are addressed. Communication, sensitivity, identification of group norms, loyalty to a group, teamwork, and sensitivity to the needs of women and ethnic and racial minorities all present enormous challenges in the changing American workforce, particularly in multicultural settings. Both American supervisors and immigrant workers need to gain an understanding of one another's cultural perspectives concerning appropriate roles and behaviors in different work situations.

Program Applications of Workplace Literacy Research

Finally, of interest in this review are program applications for workplace literacy research findings. Sticht (in Rothkupf, ed. 1989) called for a better understanding of the functional contexts of adult literacy as they differ from childhood literacy and their implications for literacy education of both children and adults. He also called for approaches to workplace literacy education that are attractive both to industry and the workforce. Such approaches no doubt need to be more focused than are basic adult literacy programs. Park, Storlie, and Dawis (1987, January) looked at the educational needs of dislocated workers in Minnesota for the purposes of determining how work-related literacy skills might be developed most efficiently. In interviewing dislocated workers, the researchers learned that most workers needed additional literacy education, including mathematics but tended not to take the courses offered. The researchers concluded that new approaches that integrate literacy and technical training must be found in order to attract such workers to programs.

Carnevale et al. (1988) considered training models intended to provide employees with basic workplace skills in both literacy and job-specific functions. Their analysis of prior information on training programs lead them to conclude that such programs were most successful when:

- they were preceded by a well-constructed action plan that included an in-house marketing campaign to marshall management and union support, and that connected the workplace basics program to the employer's competitive strategies;
- they used a systematic approach to training design, development, and delivery; and
- they incorporated an applied learning method that used a functional context approach to job-specific training (p. 17).

These principles are parallel to the Instructional Systems Development (ISD) model promoted by Belcher and Warmbrod (1987) as derived from military Research and Development. An overview of ISD's five major procedures includes:

1. **Analysis** -- determine that a training need exists, and identify what the training content should be;
2. **Design** -- determine goals, levels, content and structural parameters of the instructional program;
3. **Development** -- specify the actual learning activities and organize the activities (including tests) into an overall systematic program of basic skills training;
4. **Implementation** -- operate the program; and
5. **Evaluation** -- determine the value of the program by examining trainee outcomes (pp. 31-32).

Furthermore, the ISD procedures applied to workplace settings were predicated on a functional context to ensure that the "basic skills tasks to be taught are actually representative of the job" (p. 31) in which the trainees work. Finally, Belcher and Warmbrod (1987) also stressed, as do Carnevale et al. (1988), that one of the basic principles underlying all occupationally-related basic skills training programs, was that they support the "orientation to the mission of the organization for which the ... programs are being developed." (p. 29)

A set of eight steps in the applied approach was outlined by Carnevale et al. This set also covered the ISD procedures above. These eight steps elaborated what might be taken as the most important principles for adult workplace training, principles which ensured the desired functional context, and took them one stage further in terms of a workable model. The steps are as follows:

I. Identify job changes or problems related to workplace skills.

II. Build management and union support for skills training programs in workplace basics.

III. Present the strategy and action plan to management and unions for approval.

IV. Perform a task analysis of each selected job or family.

V. Design the curriculum.

VI. Develop the curriculum.

VII. Implement the program.

VIII. Evaluate and monitor the training program. (pp. 18-19)

Several of the features advocated by the authors above were supported by the few relevant evaluation studies found in the area. The primacy of a systems approach to training was underscored by Hoachlander and Stoddard (1987) in their study of effective training programs in the San Francisco Bay area, some of which were business/industry based. Among their findings was, "first and foremost, a 'systems approach' to training," (p. i), which was characterized most generally by a program with discrete steps and organized as part of a whole, with systematic feedback and ongoing modification.

The importance of a functional context for training was highlighted by Sticht and Mikulecky (1984) in their analysis of job-related basic skills program case studies. They concluded that "integration of basic skills training with technical training produces the best results" (p. ix) for basic skills improvement. More particularly, they found that training using job simulations and applications of the literacy training significantly increased the trainees' time on task in the learning setting, which in turn was associated with increased literacy skills.

The importance of cooperative management and union support was underscored by Carnevale et al. (1988) and was reinforced by others in their evaluations. Fields, Hull, and Sechler (1987), analyzing industry-based literacy training programs, found that literacy programs were often collaborative efforts between the company (management) and the union. In those cases where there was initial union resistance, program support developed when the benefits in improved worker performance became apparent. This underscored similar points made by Sarmiento (1989, September 28) who argued for employers getting workers involved in planning programs. He said, "Let's ask workers to use the problem solving, communication and group effectiveness skills they already possess to develop an approach to the skills gap problem that may be affecting their employer and their co-workers. Let's use the collective bargaining relationship to address this workplace literacy issue in the same way other issues of mutual interest and concern have been tackled." (p. 14)

Researchers have taken findings about workplace literacy requirements and applied them to issues of curriculum and materials development as well. Mikulecky (1989) described three major print communication problem areas in the workplace and pointed out that each required a slightly different solution. The first of these was found among what he called extreme low level literates: those unable to function independently with even simple print. He estimated this to be the smallest number of workers (less than five percent). Work site basic education programs, adult basic education classes and the like were, in Mikulecky's opinion, the best solution for this group.

The second group of workers had low basic skills which limited training effectiveness. Most of the workers in this category considered themselves to have no problems, but training instructors commented on the marginal benefits of training to such workers. Without print communication skills, workers did not tend to learn new material very well and were ill prepared for technical training. For this group, he recommended focused programs integrating specific literacy skills with technical training through training sessions on specific reading skills, such as document reading or graph reading.

The third group of workers made mistakes related to safety, or which impeded their productivity or promotability. These, Mikulecky pointed out, could happen at any literacy level. He advocated literacy task analysis or literacy audits of key job tasks to determine the extent to which literacy mistakes that were endangering lives or costing money were related to employees' low literacy skills. For these problems, Mikulecky recommended redesigning documents that may have caused problems, and designing and using job performance aids such as flow charts to take the place of traditional print materials related to problem tasks.

Sarmiento (1989) cautioned about the use of literacy audits, suggesting that such studies may jeopardize rather than promote literacy initiatives. His concern was that many workers may be worried that such a practice may jeopardize their future, fearing that their skills were being assessed and that they might not measure up. Sarmiento called for taking into account the corporate culture and the history of relationships between labor and management to determine how workers will view a literacy audit or job task analysis. He advocated union involvement through which workers would be given a voice in expressing what their needs would be for workplace literacy programs, citing a number of exemplary programs that have been established in that way. Once trust has been established and the needs of individual workers have been expressed, the need for a literacy audit can be discussed. Sarmiento believed that it was often possible to establish successful programs without conducting a formal literacy audit.

In fact, the type of audit proposed by Drew and Mikulecky (1988) looked at the job rather than the worker in order to ascertain the literacy skills and materials required by the job. This was done for the purpose of planning programs and developing materials. Since much workplace reading, as has been discussed earlier, entails document reading, using actual documents collected on the job as lesson materials provides highly relevant instruction.

Kirsch and Mosenthal (1988) advocated developing a theoretical model for identifying the skills underlying document reading, then applying this to developing instructional methods and materials. They described an elaborate method for doing so that they tested on selected items from the NAEP Young Adult Literacy Simulation Tasks. Their goal was to identify the critical variables associated with document reading task difficulty. They advocated following the same process used in the study for examining the tasks of a given occupation, identifying the range of tasks associated with any given occupation, administering tasks to a sample of workers that adequately reflected the population of users for that domain of tasks, then parsing the tasks using a special grammar created for the purpose. They concluded that such a model, once tested and validated, might provide a basis for identifying, developing and refining instructional programs that would systematically address the skills and strategies readers use to complete document tasks. Such an approach would use the theory of document design to maximize the effectiveness of documents for all users. They stated that this was particularly important given the function of documents in society and the increased need for producing and processing documents efficiently.

In a series for the Journal of Reading, Mosenthal and Kirsch (1989) provided an approach to teaching readers to effectively match their purpose for using a particular document with the document's structural organization. They began with several articles on teaching the concept of simple lists, then transferring this concept to more complex lists and to table and chart reading skills. Mosenthal and Kirsch thereby illustrated how workplace literacy programs might develop materials and approaches with practical relevance to day-to-day job reading tasks.

Mikulecky (In Lapp, Flood, & Farnan 1989) pointed out that classroom teachers could not prepare students completely for the literacy skill demands outside academic settings because teachers were ill-prepared to do so and because the demands in a given occupation differed from setting to setting. Further, he stated that there was "little reading and writing of any kind in many secondary classrooms. Workplace and other nonschool literacy, on the other hand, often involve communicating with others and reacting to various forms of print and graphics. Out of school, readers and writers usually have specific tasks, audiences, and contexts in mind." (p. 130) He advocated that teachers model real-world literacy by involving students with a wide variety of reading material: newspapers, pamphlets, user instructions, forms, announcements, tables, graphs, charts, memos, and correspondence. Teachers could then give assignments that called for accomplishing specific tasks. Tasks could be given to groups of students to carry out cooperatively in the way that workers often cooperate using literacy to solve problems. Mikulecky went on to provide specific suggestions on how teachers might involve students in gathering materials. He gave examples of assignments that will require students to apply literacy skills to problem solving. He also provided course-specific materials and activities that will assist students to develop reading skills and problems solving approaches similar to those used by adults in performing real world literacy tasks. Mikulecky stressed that "Bringing this higher-level, real-world literacy use into classrooms is extremely important, since general school-type literacy seems to have such limited transfer to out of school demands. On the positive side, bringing the real-world into classrooms can only make the school experience more interesting and challenging for both students and teachers." (p. 136)

A contrasting view to those cited, is presented by Fueyo (1988) who speaks out against what she called the "impoverished vision of literacy learning and teaching found in most ABE programs where teachers see students as economic beings whose goals are fundamentally job advancement."(p. 116) The author believed that such programs reduced literacy to "mastery over commercially programmed worksheets that focus on discrete sequenced skills. . . .little more than mechanical manipulation of a graphic code." (p. 116) She argued for an approach that focused on teaching the person who then could bring meaning to the task, rather than on providing meaning to the student by teaching the discrete skills that were missing. The author discussed the success of adult basic programs in New York City that modeled the kind of literacy instruction that she felt could best tap the capacities of adult students. She characterized such students as rich in life experience and strong in coping skills which make them excellent learners, but said they have fared poorly in a competitive learning environment.

There is much still to be learned about adult literacy and literacy in the workplace as well as about their applications to basic skills programs. Furthermore, the entire area of ESL and cross cultural communication in the workplace has been unexplored in this review. The reader is referred to a work in progress by Cichon, Grover, and Thomas being prepared for the U.S. Department of Education, Office of Vocational and Adult Education, for a comprehensive treatment of that subject.

Conclusion

Over the past decade, adult literacy researchers, Sticht and Mikulecky in particular, have significantly advanced our knowledge of workplace literacy. These researchers acknowledge, however, that much remains to be done. Additional data on the frequency, duration and nature of literacy demands across a wide range of occupations, particularly entry-level positions, needs to be collected to increase the generalizability of previous findings and to add to our knowledge of entry-level literacy demands. In addition to literacy demands across a range of jobs, it is essential to ascertain whether certain literacy demands are job specific. Of importance also is the determination of specific literacy strategies that entry-level workers use to accomplish a job task. Lastly, investigations of job eligibility criteria for various entry-level positions need to be made. Those criteria then need to be matched to the actual literacy demands of those positions in order to determine if workers are unfairly excluded from certain positions because of artificial credentialing requirements.

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IV. THE RESULTS OF FIELD TESTING THE PROTOCOL AND RATING PROCEDURES

The first section of this chapter contains the protocol for conducting research in workplace literacy field tested during this study, and discusses the usefulness of the protocol for collecting data on job literacy tasks. A second section describes the procedures developed for rating the difficulty level of these job tasks and using them to estimate the level of literacy required for the jobs under study.

Protocol for Conducting Worksite Observations and Interviews

One of the study's major objectives was to develop and test a method for assessing the literacy skills required for performing competently in specific entry-level occupations. The protocol provides data on both the minimal skills necessary to perform the job and those skills required for promotion to the next level within the organization. The protocol also enables observers to distinguish between those literacy skills required of a worker who is experienced and one who is still new to the job. For this study, a new worker was defined as one who has been at the job for one month or less.

Background to Protocol

The steps required to obtain the necessary data about a particular job are separated into three visits. The amount of time spent collecting data varies according to the complexity of the job and the duration of its component tasks. It may be possible to collect data on two different jobs in to a single day, but for clarity of description, it is assumed each job will be kept entirely separate.

The following steps provide an overview of the procedures to be followed in collecting data on a particular job. This overview is followed by procedures for implementing each step and sample questions to be asked during interviews and observations.

1. Prepare prior to the field observation by reading the notes of the person responsible for obtaining cooperation from the work site and the job description for the job to be observed. The initial draft of the protocol required a review of the relevant job description in the **Dictionary of Occupation Titles**, but this job description did not provide enough detail or a close enough match to jobs under study to be useful.

2. Conduct an introductory meeting with the manager or job supervisor to confirm arrangements or agreements already established, learn the minimum educational and physical requirements for the job, and obtain copies of manuals and other materials all employees are expected to read on the job. Examples may include employee manuals, booklets on safety, and other policy manuals.

3. Participate in a site tour of whatever portion of the worksite is appropriate to gain an overview of the organization within which the entry-level job under study is carried out.

4. Observe an experienced employee (defined as someone who has spent more than one month on the job), take comprehensive notes and collect additional documents such as forms, work orders or other written materials the worker uses to complete job tasks. (Copies of these are gathered at an appropriate point in the observation cycle.)

   The schedule for observations is determined during the interview with the supervisor, and is dependent upon the daily or weekly rhythm of the job being observed. Some jobs are highly repetitive and may require very little observation time. Others are more complex or vary over the course of a week; consequently, more time must be allocated to each observation.

5. Interview a recently promoted worker to obtain information on the difference in literacy skills required between the entry-level job being observed and those of the position to which entry-level workers may be promoted. In some instances, there is more than one position to which workers may be directly promoted; in others, there may be no other positions available to entry-level workers without additional education or more extensive training.

6. Observe a worker employed at the job in question for less than a month to look for possible differences between the literacy requirements for a new worker and for an experienced worker. In some instances, where worker turnover is relatively low or where there are few workers occupying the position at a particular site, it is not possible to conform with this step in the protocol. In that case, the most recently hired worker in that job or a worker recently transferred from another department is observed instead.

7. Observe a second experienced worker to obtain yet another perspective on the job and to confirm or modify the job tasks and literacy requirements of each task.

   Table 1 on page 17 details the number of workers actually observed at each site.

8. Develop an extended description of the job based on observation and interview results. The job description provided by the employer and the data collected by the field observer form the basis for a task analysis of the job and for a complete description of the literacy requirements for each task. Therefore, this description is built up over the three observations and the interviews. During the focus group meeting, this extended description is tested against the knowledge of the recently promoted workers and the workers who have been observed.

9. Hold a focus group meeting in which the literacy tasks making up the job are described to the employees from whom the data have been collected. They are asked to confirm or modify the initial task analysis and descriptions of literacy tasks.

10. Develop a comprehensive description of the literacy tasks of the job and of any literacy opportunity tasks associated with it, and develop a brief description of new literacy tasks required of workers promoted directly from that job. Any documents (e.g., tags, forms, printouts from computer screens) associated with literacy tasks are collected and appended to the literacy task description. Appendix B gives examples of such descriptions.

I. PROCEDURES FOR SECURING THE COOPERATION OF THE WORKSITE

Purposes

a) Secure permission in principle to assess literacy skills of entry level jobs at the site.

b) Describe the approach and purposes of the study.

c) Make initial arrangements for the study.

Procedures

1. Determine name and title of the company official with the authority to give permission to conduct the study and secure the cooperation of the employees with whom field observers will interact.

2. Arrange to meet with the person(s) identified in number 1 above to explain the study and to discuss how the company might benefit from participation in it.

3. Meet with the person(s) identified. Provide detailed information concerning the project and on-site activities. Assure this person that the site and workers will remain anonymous. Leave a written description of the project with the company.

4. Secure permission for observations at the work sites and arrange for interviews with appropriate management personnel, supervisors and, in the case of a unionized plant, the appropriate union official.

5. Obtain permission to take from the site samples of job-related written materials used by workers. Those may include manuals, work orders, forms and purchase orders.

6. Obtain information on any restraints which will be placed upon observers and whether or not other studies have been recently conducted at the site.

7. Obtain information on any recent site history or ongoing changes which may affect the job being observed. Is the job, for instance, being re-defined?

8. If possible during the same visit, meet briefly with department supervisors for the specific occupations involved. Explain the study and leave each supervisor with a written description of the study.

9. Obtain either the names of those who will be observed or set in process a mechanism for obtaining them before the first visit by a field observer. They will normally be selected by the site supervisor and will be workers who are considered to be performing their job satisfactorily. (Note that one worker to be observed will be a recently hired worker of one month or less, and two will be experienced workers). Arrange to interview one worker recently promoted from this entry-level position. If there is more than one job promotion possibility, then seek names of one person recently promoted to each job.

10. If it is possible to interview a supervisor, ask if the job tasks are repetitive and, if so, how often they are repeated. Obtain enough information to learn how long a field observer will need to spend collecting data from each worker and, if appropriate, at what times of day the field observer will need to be on site to observe each worker.

11. Determine whether interviews can be on company time. Confirm whether the time the worker spends in the focus group meeting will be outside company time and that each worker involved will be provided with an honorarium if this is necessary.

12. Arrange a date and time for the first site visit(s). Field observers will confirm the date(s) by telephone. Estimate schedule based on information from number 9 above and from the company estimate of time required for a site tour.

13. Arrange for photocopying of original materials used by workers or the removal of the materials for photocopying. Ask for permission to photograph written materials which cannot be copied, for example, safety signs on machinery.

14. Secure a room or other location where it is possible to conduct interviews and the focus group meeting with workers.

15. Obtain written descriptions of all jobs to be observed.

16. Where there is a union, meet with the union official. Explain the purpose of the study. Provide written descriptive material. Obtain permission to conduct observations of union members. Schedule data collection interviews for field observer. If there is a collective bargaining agreement defining the job to be studied, obtain a copy.

(Note: The preceding steps may differ in sequence by site.)

17. Confirm all arrangements, restrictions and any other limitations in a letter to the appropriate company official(s).

II. PRIOR PREPARATION FOR FIELD OBSERVERS

Purpose

a) Orient oneself to job and site.

b) Confirm initial site visit arrangements.

Procedures

1. Read the relevant job description(s) in the Dictionary of Occupational Titles and note any components of the job(s) indicating literacy skills are required.

2. Read the job description(s) provided by the company and note any components of the job description indicating that literacy skills are required.

3. Make a composite list of those activities which appear to require literacy skills for:

   - the entry-level job to be studied; and
   - the job(s) to which workers are promoted.

   Use this list as a basis for the observation and discussions at the site(s).

   (Note: The job description will provide an orientation to the job, but may understate or overstate the literacy skills required of the job. It serves as a basis for questioning, not as a basis for describing the literacy skills required for the job.)

4. Read any materials about the site which may have been provided when formal cooperation with workplace was sought.

5. Obtain any relevant background information on the site.

6. Read written agreement sent to site by contact person.

7. Call to confirm appointment for first site visit.

III. INITIAL SITE VISIT BY FIELD OBSERVER

Purpose

a) Establish a relationship with the relevant supervisor(s).

b) Communicate purpose and components of literacy analysis.

c) Obtain supervisor(s)' perspective of job, job requirements and hiring criteria.

d) Schedule observations.

e) Establish relationship and communicate details of analysis with union representative if appropriate.

f) Tour site to gain overview of the job(s) to be observed.

Procedures

A. Introductory Meeting With Manager or Supervisors

Confirm the steps taken to gain agreement at the site. Confirm purpose of the study:

- the information for assessing needs of job and not skills of workers.
- the information will be confidential.

Confirm the pattern of data collection which will consist of:

1. Pre-observation activities including:
   - interviews followed by a site tour (first visit).
2. Observation and interview of workers for each job:
   - shadowing of one experienced entry-level worker;
   - interview with one worker promoted from entry-level job to next level;
   - shadowing of second experienced entry-level worker;
   - shadowing of recently hired entry-level worker;
   - final interviews and focus group meeting.

B. Introductory Interview: First Visit

The organizational pattern at a particular work site may determine who will be interviewed. In some instances, it may be an immediate supervisor, in others, the director of personnel. Portions of the following questions may be asked of more than one person. If answers to these questions have been collected in a visit during which site cooperation was obtained, this information should be confirmed only.

1. As you know, I've come to learn about ____. What is the primary purpose of these jobs? (What does management see as important about the jobs within the context of the organization's purpose?)
2. Can you describe the tasks which make up each job? (Check against the list of activities requiring literacy skills.)
3. What do you require of anyone you hire for the job? Probe for minimum educational and physical requirements.

4. Are there any safety-related minimum requirements?

5. Do you conduct basic skills testing as part of the hiring process?

6. Do most applicants have the reading, writing, and mathematics skills necessary to perform the job?

7. What reading (safety manuals, policy manuals, insurance information, etc.) is required of all employees?

8. What tasks involving paperwork do new workers have trouble with?

9. Are there other parts of the job new workers have particular trouble with?

10. I'm trying to find out how much time I will need to observe the job to ensure that I see all its important functions. Are all the job components repeated on an hourly or weekly cycle, or are there some I could only see on a weekly or monthly basis? (Perhaps some components aren't performed regularly and are dictated by the job itself.)

11. Are there any unusual tasks that I can't expect to see but are critical to the satisfactory performance of the job, such as following written instructions for rapid shut-down of complex machinery because of an unexpected malfunction?

12. Is there anything I haven't seen or haven't asked about that you think is important?

13. Could you describe the requirements for the job(s) to which those in the entry-level job are promoted?

14. What suggestions do you have about procedures I should follow or issues (labor relations, confidentially, safety, etc.) I should be concerned with as I shadow the workers?

C. Discussion With Union Representative

1. Explore the extent to which the union permits flexibility in carrying out the job. For instance, is teaming with peers or supervisors possible?

2. Are there union literacy expectations? (Collect examples of materials which unions provide to workers.)

3. Mention that participants may receive an honorarium.

D. Site Tour

Purpose

1. Obtain overview of the company, its operations and employees.
2. Identify the different departments and their functions.
3. Learn the relationships among the different departments.
4. Understand the context of the occupations to be observed.
5. Get a sense of what to expect during observations concerning:
    a. noise level - where to conduct employee interviews;
    b. safety factors;
    c. routine; and
    d. employee attitudes.

E. Closing Interview

This interview should follow naturally from the site tour. Use the tour and previously gathered information to determine how much time will be required to observe workers. Arrange a schedule for second and third visits.

IV. SECOND SITE VISIT BY FIELD OBSERVER

Purpose

a) Observe an experienced employee and document the job and its literacy tasks.

b) Interview a worker recently promoted from the entry-level position to obtain information on the skills required to perform the job.

c) Obtain documents you observe workers using.

Procedures

A. Observation of First Experienced Employee

Introduction

Conditions at the work site will determine the method used to collect the information to be gained from the questions listed below.*

Option 1. Option 1 allows you to observe the worker perform the task and then move to a quiet area to ask him or her questions. If the job site is hazardous or noisy, and the job task has a small number of reading materials involved and is relatively simple, then Option 1 may be the best method. Have the worker bring all forms, manuals and easily transportable measurement tools he or she uses on the job to the interview. After asking the worker questions in a quiet area, return to the workplace and watch as the worker performs the tasks a second time. Use your second observation to clarify your understanding of the task.

Option 2. Option 2 follows the same steps as Option 1, but the field observer spends less time observing and more time asking questions about the job. For a relatively complex job that involves several printed materials and is also performed in a noisy or hazardous work area, option 2 is a better choice than option 1. For tasks which integrate several printed materials, the extra time spent talking with a worker is often needed.

Option 3. This is the optimum method. When the work area is quiet and safe enough, you can ask questions during the job performance. Ask the worker to explain each step of the procedure as she or he is performing it. This is the preferred method, and is assumed in the following questions.

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*These options are taken from Drew and Mikulecky, How To Gather & Develop Job Specific Literacy Materials for Basic Skills Instruction, Spring 1988.

Questions

The purpose of these questions is to establish rapport, introduce intent of questions, and ask for any questions the worker might have.

1. What are the main things you do on your job? Can you break your job down into separate tasks?
2. How did you learn this job?
3. How do you decide what to do, when?
4. Would you show me/walk me through the main parts (tasks) of the job? During demonstration ask: How did you decide to ..., where did you get that information, what is the name of that, etc.?
5. If observer isn't able to see all of the job, ask how long it would take worker to demonstrate all of the job components.
6. If there are parts of the job which can't be demonstrated, ask worker to please describe what he does for each part.
7. Did you do anything in the past week which was different from what you've told me about? If so, please describe it to me.
8. If this was not a usual task, did you need to do what you did? Could you have asked a foreman or supervisor to do it for you?
9. At what point in the job do mistakes occur most frequently? What causes them?
10. What accidents occur most frequently? How do they happen? What do you have to do if they occur?
11. Would you show me the manuals, books, forms or other reading materials you need to use on the job? How often do you read them?
12. What are the most difficult reading and writing requirements of the job?
13. What math and science tasks do you have to carry out?
14. Is there any technical equipment you are required to use which you haven't shown me?
15. How has your job changed since you first started it?

16. Are there any events, such as special orders, which occur infrequently, but require you to do things you haven't told me about so far?

17. Do you have any questions for me?

B. Interview With Recently Promoted Worker

There may be several different promotion possibilities; if that is the case, this interview may need to be repeated several times.

1. Which tasks were completely new to you when you were promoted to this job?

2. Would you describe each of the new tasks to me, and show me copies of any reading materials you have to use to carry them out?

3. What were the most difficult new tasks? If possible, would you demonstrate them to me?

C. Documentation and Material Collection

1. Collect copies of all reading materials that workers being shadowed use during the observation or reading materials they report needing to use at other times. You may be able to take copies of forms or to ask to photocopy those you can't take; where neither option is appropriate or possible, photograph or write down the text of the forms. An example of this type of text is safety or operating instructions on the equipment or machinery. Make sure you collect copies of completed forms so you can see how they are used.

2. Whenever you collect written material, make out a Document Summary Form (Attachment A). Take care to note the context in which it is used. Use any of the following questions as appropriate:

   - What do you use this material for?
   - How did you read/use this material when you began this job?
   - How do you use this material now?

3. Write a description of the literacy requirements of job tasks in relation to the use of such material as you observe them.

D. Confirmation of Further Observation

End visit and confirm date and time of second visit with appropriate employee(s) and supervisor(s).

V. ACTIVITIES SUBSEQUENT TO SECOND VISIT

Purpose

a) Analyze data obtained from initial observation and materials to create an initial description of the job literacy tasks.

b) Plan for the third site visit.

Procedures

Site notes, rather than job descriptions, are the basis for the following activities.

1. Draft a summary of literacy related tasks required to perform the job using your notes from observing/talking with the worker. Reference reading materials where appropriate. Use format in Attachment B.
2. Summarize the company requirements for hiring for the job.
3. Using Document Summary Forms (Attachment A), cite other materials to which a worker might need access in order to perform within the company, for example, personnel manuals, union materials, etc. Compile an appendix of the materials.
4. Draft a summary of literacy related tasks for the job to which workers are promoted.
5. List tasks which are not, on reflection, as clear as they appeared during the data collection, and integrate them into the questions to be asked of both the experienced and new worker on the second visit.

VI. THIRD SITE VISIT BY FIELD OBSERVER

Purpose

a) Observe a second experienced worker to collect data on any additional literacy tasks and confirm, clarify or modify job literacy tasks previously observed.

b) Observe an inexperienced worker to differentiate between literacy skills required of beginning and experienced workers.

c) Confirm or establish time and location for focus group.

Procedures

A. Observations

1. With the second experienced worker, repeat note taking procedures and questions used for first experienced worker.

    - Determine if there are literacy tasks the second experienced worker is required to perform which you did not observe during your first visit. If so, document them carefully.
    - Make sure to clarify the literacy requirements of tasks listed under activity VI. 5.
    - Collect materials only where they are not identical to those collected during first visit.
    - Note how the worker uses materials in a different manner from the first worker.

2. Repeat procedure with a recently hired worker. Be careful to note differences, particularly in the use of written materials by the recently hired worker and in the ways the recently hired worker obtains information needed to perform the job satisfactorily.

B. Administrative Details

1. Confirm with appropriate supervisors/managers that observations are complete.

2. Confirm time and site for focus group with those observed if this has not already been done.

VII. SUMMARY SUBSEQUENT TO THIRD SITE VISIT

Purpose

a) Create an initial description of literacy tasks for inexperienced and experienced workers, and a description of additional literacy skills required upon promotion.

Procedures

1. Using your notes from observing/talking with both experienced workers, draft a summary of the literacy requirements of each job task. Note differences between workers in carrying out the tasks of the job.

2. Repeat step 1 above for the recently hired worker. Tasks that require identical skills to those of an experienced worker need not be re-written. Those tasks that require different skills (for example, close reading of a manual to understand the task) should be clearly documented.

3. Prepare a list summarizing your observations of the literacy requirements of each job task. Where discrepancies exist, write questions for clarification by workers in the focus group meeting. Review discrepancies with the project director.

VIII. FOCUS GROUP

Purpose

a) Review task descriptions for experienced, inexperienced and promoted workers with those observed.

b) Obtain feedback to confirm or modify descriptions.

c) Confirm names and addresses of participants.

Procedures

The focus group will include all those workers observed, including the recently promoted worker, and will probably be conducted outside work hours. Workers will be reimbursed for their time.

1. Ask permission to write notes during the conversation.

2. Review preliminary findings of floor and ceiling literacy requirements from observations. Record comments of focus group members.

3. Ask for clarifications where discrepancies arise and record participant comments.

4. Ask participants to rank difficulty of literacy requirements of tasks, including difficulty of reading materials.

5. Confirm names and addresses to which honoraria should be mailed. Have each worker fill out a confirmation form that includes a social security number.

IX. FINAL DOCUMENTATION

Purpose

a) Create detailed descriptions of the literacy tasks for each job for further analysis.

Procedures

1. Use initial observation report drafts and the comments of the focus group to generate three preliminary sets of descriptions of literacy skill requirements for each of the following tasks of the job:

   - floor tasks for a recently hired worker;
   - floor tasks for an experienced worker;
   - opportunity tasks (i.e., those which workers may perform, but are not required to); and
   - ceiling tasks for the job (i.e., those tasks not essential for performing the entry-level job but required for promotion to the next job).

In each case, reference appropriate reading materials. Use the document summary forms provided.

X. PROCEDURES FOLLOWING SITE OBSERVATION

Purpose

a) Thank all involved.

b) Provide appropriate feedback to all involved.

Procedures

1. Write to workers observed to thank them for their assistance.
2. Write management and union to thank them for their assistance, and provide them with any information promised in initial contacts.
3. Send letters and certificates of appreciation to all workers and to the company.
4. Provide each site with a copy of the final project report.

ATTACHMENT C

DOCUMENT SUMMARY FORM

SITE:____

DOCUMENT:____

DATE:______________________

DOCUMENT SUMMARY

1. Name & description of document:

2. Worker and job with which document is associated:

3. Brief summary of contents:

4. Worker(s) use of document:
    a. Purpose of using document:
    b. How was document used when worker was new to job?
    c. How is document used now?

ATTACHMENT D

FORMAT FOR DOCUMENTING JOB LITERACY SKILLS

INTRODUCTION

The format for documenting literacy skills is designed to facilitate careful analysis of literacy tasks and to promote comparison with the NAEP assessment. An example of a literacy task description follows. It is critical that discrete tasks are separated from each other. Thus any job task that requires several discrete literacy tasks should be subdivided into those tasks. A discrete literacy task is defined as one which the worker does not regularly break down into sub-tasks. Thus, a point at which data from a manipulation is entered before another manipulation is initiated would represent a break between literacy tasks, as would movement from one computer screen to another.

It is likely that more than one set of data will be collected for each sub-task. For instance, if a dietary assistant is to read a menu, several sample menus would be collected by the site observer. The site observer would select the most difficult sample to document the sub-task of reading a menu, unless the observer has confirmed that the worker would routinely ask a supervisor or more experienced worker to assist him or her in reading difficult material.

If the same occupation is observed at two sites and the two sites are found to be readily comparable, a single set of descriptions will be completed for the occupation. A set of descriptions consists of:

- the literacy tasks expected of an experienced worker;
- the literacy tasks or skills expected of a new worker if these differ from the former; and
- the literacy tasks required for each job from which a worker in the entry-level position can be promoted.

Note that the literacy tasks will not always be identical to those used in the NAEP, which does not include, for instance, measurements for team work. The following provides an example of the format documenting literacy skills at one hospital site.

Task 2. Set up hospital B nourishments. (Process repeated for 2:00 p.m. and 8:00 p.m. snacks.)

2.1 Determine quantity of nourishments required.

READ &	Read nourishments list. (See document B)
WRITE	Write out individual patient nourishment tags, copying information from nourishments list.
READ & ANALYZE & COMPUTE	Use information from tags to determine quantities of items needed for set-up. Estimate total quantities of raw materials (e.g. sandwich meat) needed for the day. Determine number of sandwiches needed. e.g. 7 egg salad.

2.2 Set up nourishments.

READ	Read individual tags to determine contents of each nourishment package. Read directions for mixing commercial nourishments such as CIB*. Read product names as appropriate. E.g. juice names, etc.
COMPUTE	Weigh out meat, cheese, etc. as needed. (4 oz., 30 gms., etc.) Measure ingredients for special orders. (e.g. 250 ccs. of water to 1 package of commercial mixture. Order may be 6xCIB or 8xCIB, which must be packaged.)
WRITE	Write name and date on any bulk items made up, or on any items not be used immediately. e.g. on extra cups of CIB.

*Carnation Instant Breakfast

Criteria for an Effective Protocol

A central goal of this project was to create a generally usable protocol for conducting research in workplace literacy that would be flexible enough to be applied in different settings and to enable the field observer to collect data on a variety of occupations representing a wide range of literacy skills. Given the goals of this study, it was essential that the protocol also enable the field observer to determine the literacy tasks actually required for successful performance of the jobs under study. We determined that an effective protocol must enable the field observer to:

(1) distinguish between the perceptions of employers and supervisors concerning the literacy tasks of jobs beings studied and the actual literacy requirements of the jobs as carried out day to day by the workers;

(2) discriminate between literacy requirements and literacy opportunities (times when workers may use reading or computation on the job if they choose to do so);

(3) examine the differences in the literacy level required for an experienced worker compared to that required for a recently hired worker;

(4) identify any critical events requiring literacy skills which might not occur in the day-to-day operation of the job but which are absolutely essential to safety or cost effectiveness; and

(5) identify the differences in literacy requirements for the job to which the entry level worker would be eligible for promotion.

We tested the protocol in both industrial and hospital settings. There was considerable variation in the way work was organized and jobs were defined in the factories studied. This was also true in the hospital settings visited, where jobs given the same title were classified, described and implemented differently according to local requirements. Although we tested the protocol in only six sites, the fact that we were able to gather meaningful literacy data in such diverse settings made a good case for the protocol's usefulness in studying jobs of varying complexity in differing occupational settings. (See Table 11, p. 137.)

(1) above states the importance of being able to distinguish between perceived requirements and actual requirements of the job. The protocol required field observers to gather job descriptions, standard operating procedures (SOP's) and other materials at each site. Field observers also asked employers for their perceptions and assessment of the literacy requirements of the job. The observers found that workers often carry out the literacy tasks of their jobs in practical and simple steps that make the tasks less complex than employers might think. Management at one factory site believed workers needed a background in algebra to do statistical process control (SPC). But SPC tasks had been broken down into a series of computations involving addition, multiplication and division rather than using the format of an algebraic equation. In another setting, a computerized form used by laboratory assistants to identify patient test results had been designed to require matching five different pieces of information, but the workers actually matched three rather than five features to identify the correct patient and test results.

(2) requires that the protocol enable field observers to make observations that distinguish between literacy requirements and opportunities. Although workers had the opportunity to refer to SOP's or manuals in order to determine how to carry out a procedure or to find needed information, most often workers asked another worker or supervisor to show them or tell them what they needed to know. While studies have shown that superior workers at every level know the powers of literacy and how to use reading and computation to perform their jobs more effectively (Diehl & Mikulecky, 1980; Mikulecky & Echlinger, 1986), we observed that in day-to-day operations, whether in the factory, the laboratory or the hospital kitchen, "show and tell" was the preferred means of gaining necessary information. Workers

also circumvented performing computations, or simplified the type of calculations required. For example, rather than multiplying and dividing to determine how many boxes of a certain height could be stacked on a shipping skid, they estimated or performed simple addition. Rather than adding up the number of slices of cheese needed to fill snack orders for patients, dietary aides flipped through the orders and estimated the amount to bring from the refrigerator, making additional trips if their original estimate fell short of actual requirements.

(3) calls for a protocol that allows field observers to examine the differences in literacy requirements during training as compared to those for experienced employees. We observed that experienced workers had memorized information or procedures that they used repeatedly. New workers had to read the computer fields provided by menu-driven software for ordering materials, while those experienced with the procedures entered numbers or data almost automatically. Experienced nutrition assistants knew the amount of protein, carbohydrate, and fat in commonly ordered foods, while more recently hired workers had to refer to a chart for the information.

(4) highlights the necessity for identifying any critical events not seen during the observation that might be essential literacy tasks. The protocol required that two methods be used to insure that these unobserved literacy tasks be identified. The first method called for the field observer to ask the worker, "Is there anything you have to do only once in a while that you haven't shown me?" We have found that the answers did not reveal any significant literacy tasks not already identified. The second method called for photographing or writing down any signs or notices posted in the work site. Machine operation safety procedures in factories were usually implemented through pressing prominent red buttons or pulling red cords and did not require reading instructions to implement them. However, posted safety procedures for toxic chemicals involved a complex set of instructions written above 12th grade reading

level. Occupational Safety and Health Administration (OSHA) regulations required all workers to be trained in these procedures. An example of a critical literacy event was noted at a hospital where signs on the doors of immune deficient patients required that anyone entering wear a mask. An illiterate dietary aide might not have been able to read such a sign and thus might have exposed the patient to illness while delivering a food tray or collecting a menu. Written instructions posted near fire extinguishers also provided an example of a critical literacy event that might have posed a safety hazard if workers could not have read the sign. Such tasks did not emerge as the most difficult literacy requirements for the jobs studied, but the protocol enabled field observers to collect information about such key events for consideration in determining the literacy level of the occupations studied.

(5) calls for a means of looking at not only the literacy skills needed for the entry-level job but also the skills needed for promotion. Employers have an interest in hiring workers who will stay with the company, and often the opportunity for promotion or for taking on more responsibility offers incentives to workers to continue on the job. Our protocol called for an interview with recently promoted entry-level workers to determine what new skills were needed in this new job that were not required in the entry-level job; the protocol also suggested having these skills demonstrated where possible. Interviews were useful in providing data on workers' perceptions about the most difficult new job requirements, such as supervisory and interpersonal skills, teamwork, and the like. The data did not provide us, however, with an accurate assessment of the level of difficulty of reading, writing, or computation tasks described by the interviewee as being more difficult because the data gathered was based on worker perception rather than on field observers' observations. In order to assess the level of difficulty of the job literacy tasks performed by promoted entry-level workers, observations would be required.

Using the Protocol For Research Purposes

Field observers must be carefully trained in both the protocol and the rating procedures, so that their observations are focused on identifying the most difficult reading, writing, computation, speaking, and listening tasks. The protocol takes the field observer through each essential step in data collection and in triangulation of data. The protocol allows for timely identification of apparent inconsistencies or gaps in the data, and gives a means of resolving them during the time on site.

The length of time involved in gathering the necessary data using this protocol varies with the complexity and variability of the job being studied. It is important to note that the time required for worker observations must vary not only with the complexity of the job but also in relation to the work flow. Work must continue at whatever pace the context of the job dictates, and unobtrusive observations must be scheduled around workers' time constraints. This is especially important because workers' tasks usually impact on the next activity of other workers. Observers may thus experience periods of "down time" while waiting for workers to begin a new set of tasks. Such time is useful for organizing and reviewing notes, collecting documents, listening to and observing other workers and supervisors, or gathering written materials at the site.

Based on our experience, we estimate the total time onsite could be as much as three days if the observers were unfamiliar with the work site.

In hospitals, a tour of the department provided sufficient orientation, whereas in manufacturing sites, a tour of the department in which the product line was being made was also essential. It was also helpful to visit other areas in manufacturing sites, such as the quality control laboratory or the lines where raw materials were processed. Approximate time for each activity is estimated as:

- one hour for initial visit to gain cooperation and background information;
- one hour for management and labor union interviews;
- 30 minutes to one hour for site tours; and
- 12 to 24 hours, depending on the complexity of the job, for observations, interviews, and focus group process.

This time block can further be broken down into the following components:

a. a few hours to a full day for observation of all relevant job tasks;

b. one to two hours for writing up literacy tasks, and for noting questions and information gaps;

c. a few hours to a full day for observations of a second experienced worker and a new worker (time needed on these second observations will be less than for first observations);

d. one to two hours for preparation for final focus group meeting; and

e. 30 minutes to one hour for the focus group meeting.

Once the site data collection was completed, the next task called for by the protocol was data analysis. This consisted of organizing and writing up the observation data, identifying and rating the most difficult job literacy tasks. This step involved another one to two days' time, depending on the complexity and number of literacy tasks in the job. Of course, during this initial study, the process of rating, testing, modifying, and re-testing procedures took much longer.

Based on our experience in studying two to three jobs of varying complexity at six quite different workplaces, we believe that the protocol for studying the literacy level of specific occupations meets the criteria for which it was designed and provides a common approach to gathering comparable data on the literacy requirements of jobs. Applications for the protocol are discussed in the conclusions chapter.

PROCEDURES FOR ANALYZING WORKPLACE LITERACY TASKS

The procedures outlined here were intended to test a protocol for matching items from the National Assessment of Educational Progress (NAEP) Young Adult Literacy Assessment to workplace literacy tasks performed by workers in selected entry-level jobs.

The procedures for analyzing workplace literacy tasks were designed to:

1) document the nature and relative frequency of literacy tasks in the workplace;
2) document a systematic approach to determining the relative difficulty of literacy tasks observed;
3) match the most difficult job literacy tasks to the NAEP test items; and
4) use this procedure to estimate the percentage of the population able to perform at the literacy level expected of entry-level workers in each of the jobs studied.

An initial examination of the thinking behind the NAEP Young Adult Literacy Simulation Tasks indicated that this matching procedure could not be achieved through a mechanical process. Rather, it required an understanding of the framework supporting the NAEP literacy scales and scores. The next two sections describe the conceptual framework of the NAEP disclosed in **Profiles of Young Adults** (Kirsch & Jungeblut, 1986), and the scales developed to assess literacy. The following sections describe the operational definitions and scales we developed to analyze workplace elementary data, and the steps we have followed in the analysis process. Only the final step of our analysis procedure, that of matching the most difficult literacy tasks for each job to the NAEP Young Adult Literacy simulation task items, requires access to the NAEP items themselves.

Framework of the NAEP Literacy Profile

The NAEP assessment of literacy is based upon a series of simulations of everyday activities that people encounter at work, at home, at school, and in their communities. The organizing framework for all the scales except oral language was that although literacy is multidimensional, the literacy skills of respondents would be assessed upon their ability to successfully manipulate printed material. Only eight items on the test assessed oral communication skills independently of the respondent's ability to read.

The organizing matrix used to develop items based upon reading skills addressed both the type of printed material (sign/label, directions, memo/letter, form, table, graph, prose, index/reference, notice, schematic or diagram, advertisement, and bill/invoice) and the use of or purpose for reading the material (knowledge, evaluation, specific information, social interaction, and application). A graphic form of the organizing matrix for the simulation tasks is presented on the following page. "X" indicates that NAEP simulation tasks exist for those materials and uses so indicated. NAEP's rationale for developing questions for those cells with an 'x', was that while one could have developed tasks to fill each cell in the matrix, many of the tasks would not have been representative of tasks which individuals frequently encounter. For example, a person does not typically read a set of directions for the purpose of evaluation.

Items from these cells were incorporated into three scales, a prose literacy scale, a document literacy scale, and a quantitative literacy scale. Intercorrelations between the scales ranged from .49 to .56 (Kirsch & Jungeblut, 1989, p. 5), providing evidence that literacy skills should be separated along these different dimensions.

The data from the simulation tasks on these scales were anchored along the NAEP reading proficiency scale, which was designed to extend from 0 to 500 with a mean of 250 and a standard deviation of 50. The criteria set by the NAEP for selecting items at each anchor point were that 80 percent or more of the respondents who were at that point were able to answer that question correctly, while less than 50 percent of those at the next lower level answered it correctly. Thus the three scales represent both the performance at a given level of difficulty as well as the combination of characteristics interpreted to be associated with performance at increasing levels of difficulty (Kirsch & Jungeblut, 1986, pp. 9-10).

Matrix of Materials and Uses Indicating

Cells for Adult Literacy Tasks

MATERIAL	USE				
	Knowledge	Evaluation	Specific Information	Social Interaction	Application
Sign/Label			X		X
Directions					X
Memo/Letter				X	
Form		X	X		X
Table		X	X	X	X
Graph		X	X		
Prose	X	X	X	X	
Index/ Reference			X		
Notice		X	X		X
Schematic			X		X
Ad			X		X
Bills			X		

Literacy Scales

1. The Prose Comprehension Scale

This scale assesses three different aspects of comprehension: a) matching information from a question to identical or corresponding text information; b) producing or interpreting text information; and c) generating a theme or organizing principle from text information. Although conceptually these may be considered as being of ascending levels of difficulty, responses to the NAEP items indicated this was not necessarily so. The following table, excerpted from the NAEP report (Kirsch & Jungeblut, p. 19), demonstrates the nature of overlap among the three different aspects of comprehension and the difficulty level of selected tasks. This overlap reveals the importance of distinguishing between conceptual hierarchies of difficulty and the frequency with which tasks were actually answered correctly, as determined by the NAEP results.

Selected Tasks and Corresponding Levels of Difficulty Defining the Three Aspects of the Prose Comprehension Scale

	Selected Prose Comprehension Tasks		
Levels of Difficulty	Matching Literal and Corresponding Information	Producing and Interpreting Text	Generating a Theme
500			
400	-3-feature match from newspaper article (corresponding) (397)*		
375		-Interpret job-related benefit classification (371)*	-Generate theme from single unfamiliar metaphor (387)*
350			-Generate theme from repetitive argument widely dispersed (340)*
325			
300	-3-feature match from a page of text in an almanac (literal) (281)*	-Interpret appliance appliance warranty (279)*	-Generate familiar theme from argument (278)*
275			
250			
225	-1-feature match from newspaper article (corresponding) (210)*		
200		-Produce text with personalized background (199)*	
0			

*Designates that point on the scale at which individuals with that level of proficiency have an 80 percent probability of responding correctly.

2. The Document Literacy Scale

Each task on this scale is introduced with information presented as a question or directive. The most important descriptors of task difficulty are the following:

a) the number of features the respondent must first identify in the question or directive and then match to features of information in a document;

b) the degree to which information given in the document corresponds to the requested information; and

c) the number of exemplars in the document which have at least one feature in common with those in the question and thus serve as possible distractors or correct answers.

Two other factors are described as having an influence on task difficulty:

d) whether a response requires personal knowledge or information from a text; and

e) whether a response procedural knowledge that must be brought to bear from prior experience.

The following table (Kirsch & Jungeblut, 1986, p. 28) provides an overview of the degree of difficulty of each of the NAEP examples. This document literacy scale provides a more useful guide for assessing the degree of difficulty of workplace literacy requirements for entry-level jobs than does the prose scale. Most reading and writing tasks performed on the jobs require workers to read or write forms, tags, graphs, charts and other documents.

Selected Tasks and Corresponding Levels of Difficulty Defining the Document Scale

Level of Difficulty	Selected Document Tasks
500	
400	
375	
	-6-feature match: Bus Schedule (Several Exemplars) (365)*
350	
	-4-feature match: Bus Schedule (Several Exemplars) (334)*
325	
300	
275	-1-feature match: Filling-in Checks: Dollars # (259)* (Proced. Knowledge) Date (257)* Dollar (256)* Pay to (254)*
250	-2-feature match: Pay Stub: Gross, Year-to-date (257)* (Several Exemplars) Map: Location (249)*
225	
200	-1-feature match: Pay Stub: Current Net Pay (189)* (1 Exemplar) Meeting Room Form: Date (182)* Time (169)*
175	
150	
125	-1-feature match: Sign Name (110)* (Personal Knowledge - 1 Exemplar)
0	

*Designates that point on the scale at which individuals with that level of proficiency have an 80 percent probability of responding correctly.

3. The Quantitative Literacy Scale

The descriptors of difficulty for this scale consist of:

a) the type of operation;

b) the number of operations; and,

c) whether the respondent is required to enter or disembed data in order to complete the operation.

In increasing order of difficulty, the quantitative literacy scale is as follows:

- addition or subtraction of two items (one operation);
- entry of data and subsequent addition or subtraction of two items;
- two sequential operations involving addition or subtraction, or application of a higher level operation (multiplication or division);
- computation of a percentage; and
- disembedding the appropriate features of a problem and then explaining the sequence of operations respondents employed to solve it.

The table (Kirsch & Jungeblut, 1986, p. 33) below indicates the relative difficulty of selected examples of quantitative tasks.

Selected Tasks and Corresponding Levels of Difficulty Defining the Quantitative Scale

Level of Difficulty	Selected Quantitative Tasks
500	
	-2 Operations: Multiplication & subtraction plus feature match (489)*
400	
375	
	-1 Operation: Multiplication: Lunch Menu = Tip (356)*
350	
325	-2 Operations: Addition & Subtraction: Lunch Menu - Change (337)*
300	
275	-1 Operation: Addition plus feature match involving entering and calculating checkbook balance (293, 289, 281, 281)*
250	
	-1 Operation: Addition using deposit slip (233)*
225	
200	
0	

*Designates that point on the scale at which individuals with that level of proficiency have an 80 percent probability of responding correctly.

4. Oral Communications Scale

The oral communications scale was developed using a different schema. A matrix of items was developed to test the respondent's ability to provide information, to relate a narrative, and to speak persuasively. Each response (which was audiotaped) was rated as to whether it was non-existent, minimal, acceptable, or superior. Respondents' scores were not scaled in the same way as those for the other three scales. Instead, responses were compared to those on the NAEP reading scale.

Steps in Rating the Difficulty Level of Job Literacy Tasks

This section describes the steps to take in rating the difficulty level of literacy tasks observed on the job using the NAEP Young Adult literacy simulation task scales as a point of departure. There are four steps. First, break down literacy tasks into sub-tasks that describe precisely what workers are required to read, analyze, or otherwise manipulate in a single step. Second, determine the type of literacy task involved by using the matrix of materials and uses. Third, identify the appropriate scale and fourth, place the task at the appropriate point on the scale selected.

We created prose, document and quantitative literacy scales against which to match work site literacy data based upon information we have been able to gather about the NAEP from the Kirsch (Kirsch & Jungeblut, 1986) report. In some cases, levels on the scale were extrapolated from the limited information we had at our disposal in order to cover all the combinations of possibilities we were likely to encounter. We included more rather than fewer steps on each scale in an attempt to determine just how accurately we could match items to the NAEP literacy scale. Directions for carrying out the rating procedures follow.

I. BREAK LITERACY TASKS INTO SUB-TASKS.

In order to rate the difficulty level of complex tasks, we divided them into less complex sub-tasks. We divided each literacy task into the components a worker was required to address in a single transaction. For example, in the case of a worker using menu-driven computer software, each separate screen of instructions, information, or questions on the computer screen to which the worker is required to respond should be considered a separate literacy task.

II. MATCH EACH TASK TO THE MATRIX OF MATERIALS AND USES.

Match each task to the Matrix of Materials and Uses Indicating Cells for Adult Literacy Tasks. To do this, code each literacy task with the appropriate Arabic numeral and letter. Note that three additional items have been added (13, 14 & 15) to the NAEP scale to accommodate the variety of tasks we observed. Uses or purposes are operationally defined as follows:

- Knowledge: reading to integrate information, to remember sets of factors for later use, or to go beyond information given.
- Evaluation: comparing and contrasting points of view; using printed or spoken information to make a reasoned judgment.
- Specific Information: locating a specific fact to satisfy a particular need (e.g., looking up a fact in a reference book).
- Social Interaction: organizing and sequencing information to communicate to another person or group (e.g., preparing a memo, writing a letter, orally explaining something that is read).
- Application: following oral/written instructions to construct, make, or repair something; doing simple numerical calculations based on printed information; providing simple facts such as is required in the completion of forms.

This matching process is used to create a frequency chart of the types of literacy tasks required for each job studied and enables comparison with the distribution of the NAEP items. It is also used to determine the literacy scale to which each task should be matched.

Matrix of Materials and Uses Indicating Cells for Adult Literacy Tasks

MATERIAL	USE				
	Knowledge A	Evaluation B	Specific Information C	Social Interaction D	Application E
1. Sign/Label					
2. Directions					
3. Memo/Letter					
4. Form					
5. Table					
6. Graph					
7. Prose					
8. Index/Reference					
9. Notice					
10. Schematic					
11. Ad					
12. Bills					
13. Goods					
14. Scale/Measuring Device					
15. Oral					

III. MATCH EACH LITERACY TASK TO THE APPROPRIATE SCALE.

The second step in the process is to select the literacy scale appropriate to each literacy task. This requires that each literacy task be broken down into sub-tasks. The prose and document scales are the only ones between which there may be confusion. In general, any task which requires reading data from or entering data onto a form or screen should be designated a document task. Any task which requires reading prose from a book or original text in a sentence form should be designated a prose task.

IV. PLACE EACH LITERACY TASK AT THE APPROPRIATE POINT ON THE CHOSEN LITERACY SCALE.

The prose, document, quantitative and oral literacy scales that follow are arranged in descending order of difficulty. The intervals between points on each scale are not necessarily equal. These are ordinal scales designed primarily as a heuristic useful for assessing the relative difficulty of literacy tasks. The numbers appearing at the left of each definition on the scales are used solely to code job literacy tasks, and a number on one scale is not of comparable difficulty to the same number on another. The following page contains the scales to be used in rating data from field observations.

TABLE 2: PROSE COMPREHENSION SCALE

Matching Literal and Corresponding Information

7a Match of more than three features of corresponding information.
6a Match of three features of corresponding information.
5a Match of more than three features of literal information.
4a Match of two or three features of literal information.
3a Match of two features of corresponding information.
2a Match of one feature of corresponding information.
1a Match of one feature of literal information.

Producing and Interpreting Text

5b Higher skill.
4b Interpret two sets of written data and compare and contrast the information in the two.
3b Interpret a written directive.
2b Write several sentences using prior knowledge.
1b Lower skill.

Generating a Theme or Organizing Principle

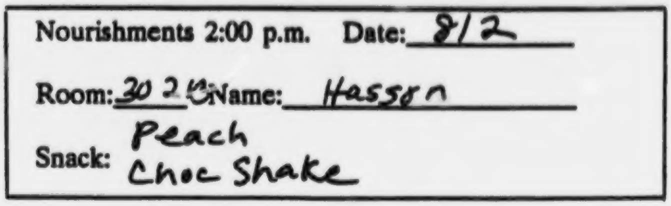
4c Generate a theme from a short text or unfamiliar metaphor.
3c Generate a theme from widely dispersed information in a longer text.
2c Generate a theme from a short text and familiar metaphors.
1c Lesser skill.

TABLE 3: DOCUMENT LITERACY SCALE

7 Six or more feature match with several exemplars (perhaps including procedural knowledge).
6 Four or five feature match with several exemplars (perhaps including procedural knowledge).
5 Two or more feature match requiring prior procedural knowledge.
4 One feature match requiring prior procedural knowledge.
3 Two or three feature match with several exemplars.
2 One feature match with several exemplars.
1 One feature match with one exemplar, one feature match with one exemplar and requiring only personal knowledge or lesser skill.

The term **"features"** refers to the numbers of different items with which the respondent will have to deal in a single transaction or sub-task. **"Exemplars"** are the possible items on the document, form, or other source from which a worker chooses to find the information needed to complete a task. Exemplars may include spoken information. As an example, the nourishment tag from Hospital Site C below contains several features (date, room, name, snack), but each feature has only one exemplar.

Nourishment Tag
Hospital Site C



Nourishments 2:00 p.m. Date: 8/2

Room: 302 C Name: Hassan

Snack: Peach
Choc Shake

A dietary aide filling out a patient's fluid intake chart must first distinguish the fluid (feature) orange juice from list of possible beverage choices (exemplars), then determine the number of ounces in a serving of juice.

"Procedural knowledge" is defined as knowledge acquired through prior training or work experiences that enables the worker to make choices and decisions concerning the activities or actions to be taken in order to successfully complete a task. This differentiates between those tasks for which a worker has to follow a set procedure and those tasks which used prior knowledge but not a set procedures. Thus, knowing that two or more specific numbers must be added together to arrive at total caloric intake is considered procedural knowledge. Knowing whether juice is stored in one compartment in a refrigerator or another is not essential (both of the two refrigerators compartments could be checked) so is not considered procedural knowledge.

TABLE 4: QUANTITATIVE LITERACY SCALE

6 More than two operations with at least one involving multiplication or division and requiring a feature match.
5 Two operations with at least one involving multiplication or division and requiring a feature match.
4 One operation requiring multiplication or division.
3 Two or more operations, addition and subtraction.
2 One operation, plus feature match and data entry.
1 Addition or subtraction of two items (one operation), no data entry required or lesser skill.

For the purposes of rating job tasks, assume workers are not actually making calculations unless you directly observe them doing so. Rank counting, weighing, or tallying as "lesser skills".

TABLE 5: ORAL LANGUAGE SCALE

3 Persuasive speaking.
2 Narrative speaking.
1 Provision of simple information.

Some tasks may not be appropriate to any of these scales. If this occurs, the task should be documented for further analysis (and for possible inclusion in future discussion on the extent to which the NAEP matches workplace job tasks).

V. RANK TASKS IN ORDER OF DIFFICULTY AND SELECT THE MOST DIFFICULT ON EACH SCALE.

Placing tasks on each of these scales results in ranking them. The highest ranked tasks, considered to be the most difficult, will then be matched to the NAEP items when those become available to us. In some instances, it may not be possible to select the single most difficult job task on each scale because the information released concerning the NAEP is inadequate for making the necessary distinctions between tasks. In this case, it may be necessary to select two or more tasks for further analysis. All selected tasks should be carefully documented.

The product for each job (and initially each job site) is a matrix of the most difficult literacy task as follows:

		Job Title:	
	New Worker	Experienced Worker	Opportunity
Prose scale	Task description	Task description	Task description
Document scale	Task description	Task description	Task description
Quantitative scale	Task description	Task description	Task description
Oral Scale	Task description	Task description	Task description

Not all cells in this matrix will necessarily be filled. For instance, many of the workers we observed were not required to undertake tasks that fall on the prose scale. In addition, where job sites did not have novice workers who had been on the job for one month or less, the New Worker category will not have any entries.

The format for documenting each literacy task selected will be the following:

SKILL TASK (e.g. Read)

Task:	Short description
Sub-Task	Textual description of literacy task.
Code for matrix, scales, & level	

Use the following code for referring to scales and levels on the scale.

Prose Scale	PR
Document Scale	DOC
Quantitative Scale	QUAN
Oral Scale	OL

Add the level on the scale after the scale code, e.g., DOC 1, QUAN 4

Field Testing Rating Procedures

The purpose for developing the Procedures for Analyzing Workplace Literacy Tasks was to create a reliable, clear and simple method for conveying the relative difficulty of entry-level tasks and for equating those to the literacy skills of the general population. If we could accurately match the literacy tasks we observed in the workplace to the literacy simulation tasks on the NAEP Young Adult Literacy Assessment, it would be possible to estimate the percentage of workers entering the work force with entry-level skills, and to establish indicators of the relative difficulty of the assessed jobs. At a more general level, it would still be possible to convey the relative difficulty of entry-level jobs even if it were not possible to exactly relate the literacy tasks to the NAEP through the use of actual assessment task items.

Steps in Rating Job Literacy Tasks

The first step in the process requires breaking down complex tasks into simpler, individual tasks. Once this had been achieved, the next process was to rate each individual task. As has been discussed, rating each literacy task required three additional steps:

- determine the type of literacy task according to the materials involved and the use to which they were put;
- determine whether the task entailed quantitative skills, document or prose reading skills, writing, or use of oral language skills; and
- match the literacy task to the appropriate point on the selected literacy scale.

We will discuss our experience with field testing each step in some detail.

The rater first determined the type of literacy task represented. This was done by locating the task on a matrix of materials and uses. (See page 112.) Two difficulties immediately presented themselves. The first related to the sources of information that workers used to perform literacy tasks. All tasks in the primary battery of the NAEP items originated from written information and ended with a written response to the task. One can conceptualize the NAEP tasks as requiring input from written material, computation or another type of problem solving analysis (perhaps following a learned procedure to accomplish the analysis), and a written response as output. The sources of information and the uses to which they were put were much more varied in the workplace than those discussed on the NAEP matrix. The following table shows alternative sources of input, analysis techniques and output. It demonstrates the variety we found in the workplace.

TABLE 6: EXAMPLES OF TYPES OF WORKPLACE TASKS REQUIRING LITERACY

	Input	**Analysis**	**Output**
a.	Read*	Compute	Act on goods, etc.
b.	Listen	Compare/match	Write
c.	Observe	Act	Speak

*Underlined types represent literacy skills; others describe related cognitive processes or use of prior knowledge.

To accommodate this variety, we added two items to the NAEP scale of materials: goods and scale/measuring devices. For example, a dietary assistant used a scale to determine the weight of meat portions, so the reading on that scale was the data source. Another example was that other workers listened to verbal requests or directions as the source of information and then completed an established procedure using that information.

The second difficulty or lack of match arose from the fact that definitions of the nature of the NAEP Young Adult Literacy Simulation Tasks themselves were written for test items. We did not modify these definitions since our primary purpose was to match workplace literacy tasks to items on the NAEP. However, we believe it would be appropriate to modify the definitions to the needs of the workplace if the definitions were to be used to systematically classify workplace literacy tasks.

Table 7 on the next page summarizes the total number of literacy tasks we observed by matrix cell. Those numbers underlined or cells with an 'X' in them represent the cells for which the NAEP items were developed. For example, in our study we found 143 tasks or subtasks in which forms were used for application tasks in the work site. The NAEP items assess this skill. On the other hand, we saw 13 instances of workers referring to a set of directions for a piece of specific information, a skill not measured on the NAEP. Seventy-six percent (278 of the 367) of the instances of materials use observed was covered by NAEP literacy simulation tasks. This reveals a relatively good match between the cells for which NAEP items were developed and those representing skills required for entry-level jobs.

TABLE 7: TOTALS: MATERIALS AND USES FOR LITERACY TASKS OBSERVED

MATERIAL	USE				
	Knowledge	Evaluation	Specific Information	Social Interaction	Application
Sign/Label		1	7*		46
Directions			13		6
Memo/Letter				3	10
Form		2	23		143
Table		X	21	X	3
Graph		X	1		7
Prose	X*	X	13	X	1
Index/ Reference			X		1
Notice		X	X		X
Schematic		3	X		X
Ad			X		X
Bills			X		18
Goods					20
Scale/ Measuring Device					25
TOTAL		**6**	**78**	**3**	**280**

GRAND TOTAL 367

***Underlined numbers and "X" represent cells for which there are NAEP items.**

Using this matrix, a researcher can compare literacy materials usage in one particular entry-level job to that in another. This comparison added to our understanding of the literacy requirements in entry-level jobs beyond what could be seen by comparing the ratings of the most difficult job literacy tasks across jobs. For example, the most difficult tasks for both the dietary aide and the laboratory assistant at Hospital Site B were rated DOC 6. But the dietary aide performed only 33 literacy tasks during the course of the observation, as compared to 93 such tasks done by the laboratory assistant. Ten of the dietary aide's tasks entailed interactions with goods and materials; the remainder entailed reading labels and forms for specific information. Thirty-three percent of the laboratory assistant's reading was done for specific information and about 60 percent of it entailed using literacy skills for application purposes.

The second step in rating a task consisted of determining against which scale a particular literacy task should be matched. The four scales were: quantitative literacy, document literacy, prose comprehension, and oral communication. The use of two scales was obvious: the quantitative literacy scale was used wherever mathematical literacy skills were assessed, and the oral communications scale wherever speaking or listening skills were measured. The document and prose literacy scales were used where reading or writing skills were required of workers. The prose comprehension scale assessed three different aspects of comprehension: a) matching information from a question to identical or corresponding text information; b) producing or interpreting textual information; and c) generating a theme or organizing principle from textual information. The prose scale was used whenever a worker had to read or write several sentences or more of prose in the workplace. The document literacy scale was used primarily for assessing the literacy skills required to manipulate forms, form-like written communication and the use of computer screens. This scale was the most frequently used of any of the scales and much more commonly appropriate to workplace tasks than the prose comprehension scale.

In general, raters had no difficulty in matching literacy tasks to scales. The final, and most taxing step in the procedure, was to match the literacy task to the appropriate point on the chosen literacy scale.

The developers of the NAEP made a number of conceptual assumptions in determining the relative difficulty of different types of tasks. They assumed, for instance, that multiplication is more difficult than addition, and that several mathematical operations are more difficult than a single one. They also assumed that communicating simple oral information was a more simple skill than persuasive speaking. They then built test items around these conceptual assumptions to determine the percentages of young adults who could in fact respond correctly to the test items. An analysis of the responses then assessed the accuracy of those premises. If they proved correct, our task of creating criteria for matching workplace literacy tasks to the NAEP was easier. This was the case for the developers' assumptions about mathematics skills and oral communications skills (measured on a simple three-point scale) which proved to be relatively accurate. However, those assumptions about the relative difficulty of writing and reading skills were less accurate, either because the hypotheses upon which they were based were inappropriate or because some of the relatively difficult test items related closely to skills successfully taught in schools. This made it more difficult to use a heuristic to accurately assess the relative difficulty of some reading and writing tasks, particularly those on the prose scale. Yet in most cases, the conceptual framework of the NAEP and the examples of items which did not fit within the framework provided sufficient evidence for clear guidelines, and trained raters were able to attain a relatively high degree of agreement about the relative difficulty of tasks.

Matching Literacy Tasks to the NAEP Scales

Our plan was to place the most difficult literacy tasks we identified for each job on the rating scales described and then to compare the tasks to the NAEP items. In this way, it would be possible to use the scales to estimate the number of young adults who could perform the task without any additional literacy skills training.

We were unable to complete the final step in our comparison, since the NAEP items were not available to us in time to do so. Nevertheless, we found that the rating scales were useful for determining the relative difficulty of job literacy tasks. Table 10 on page 132 shows the ratings of the most difficult job tasks for all entry-level jobs at all the sites we studied. The rating scales show the relative difficulty of the literacy demands of manual jobs in light industry as compared to those of highly clerical jobs such as a hospital nutrition assistant or laboratory assistant. The scales also differentiate between the levels of difficulty of jobs like packer at Manufacturing Site A and inspector/packer at Manufacturing Site B, which are similar jobs but implemented differently.

The following is an example of a simple literacy task with accompanying reading materials of the type commonly collected at the sites we observed. The task required the integrated use of reading, writing, and computation at a basic level using information from forms.

Sample Literacy Task Analysis

The following is an example of a job task and accompanying reading materials commonly used at the sites we observed. It has been divided into literacy tasks and analyzed using the relevant literacy scales.

Sample Task, Dietary Aide, Hospital C

Set up Hospital B nourishments. (Process repeated for 2:00 p.m. and 8:00 p.m. snacks.)

	2.1	Determine quantity of nourishments required.
	READ	Read nourishments list. (See document B)
4E	&	
DOC	WRITE	Write out individual patient nourishment tags, copying information from nourishments list. (See document A)
	READ & ANALYZE &	Use information from tags to determine quantities of items needed for set-up.
13E QUAN	COMPUTE 1	Estimate total quantities of raw materials (e.g., sandwich meat) needed for the day. Determine number of sandwiches needed, (e.g., seven egg salad).

Document A: Nourishments Tag

Nourishments 2:00 p.m. Date: 8/2

Room: 302 B Name: Hasson

Snack: Peach
Choc Shake

Document B: Portion of Nourishment List

Ward 2E Date 8/2 Ward 2-E Date 8/2 Ward 2E Date 8 2

	Mid-Morning Nourishments		Afternoon Nourishments		PM Nourishments	
1.	302B Hassin	Melon	302B Hasson	shake Nect. or Peach	302B Hasson	½ turk sand.
2.	302C		302C		302C	
3.	303A Harwell	Choc C/B Peach or mel.	303A Harwell	PBJ Sand Choc C/B	303A Harwell	Shake
4.	303B	—	303B	—	303B	—
5.	303C	—	303C	—	303C	—
6.	304A Turner	canned fruit shake	304A	—	304A Turner	Tuna Sand + RB

The task was divided into literacy sub-tasks, which were to be completed separately. The information source was a form, and the task required application, so the initial task in the process was located at 4E on the Matrix of Materials and Uses (p. 112). The task involved a brief text, document rather than prose, so it was to be matched to the Document Literacy Scale.

The first sub-task required of the worker was a reading and writing task, consisting of selecting the name of a patient from the nourishments list and copying the information about that patient, including name, room number and the snack ordered, onto a nourishment tag. Although the nourishments list was a lengthy one (only a portion of it is included here), the dietary assistant did not have to deal with more than one name at a time, and could match first the date, then room number, and then nourishments to name. This process required no particular procedure as there was no single set of steps required to arrive at correct completion of the task; however, experience was required. The task did require matching three features, one at a time (the patient's name, room, and date), and a fourth feature, snack, of which there may be several exemplars if substitutions were required. This subtask was thus placed at level two on the Document Literacy Scale.

The second sub-task consisted of reading through the nourishment orders and estimating the amount of each type of nourishment required. This was a simple counting task and the dietary assistant was not required to be particularly accurate. It did not matter if several packets of crackers were brought out and not used, or if the dietary aide needed to make an additional trip to the refrigerator to take out several more half pints of milk. This task fell on the lowest step of the Quantitative Literacy Scale (QUAN 1).

We will discuss the results of our observations in more detail in Chapter V. For the purposes of this discussion, it is sufficient to note that we found our rating scales useful in making comparisons within and across job categories and industries.

Usability of Rating Procedures

A major objective of the project was to develop a rating procedure usable for assessing a variety of jobs of different occupational clusters. The procedures and sample data from our study were sent to two workplace literacy experts who were asked to follow the procedures and to rate the data. They reported being able to follow the logic of our definitions of terms such as procedural knowledge. The consultants agreed with project raters on the ratings given to specific literacy tasks, but they questioned whether the procedures could be widely adopted or whether the skills required for using these rating scales would limit the scales to researchers or to those who had received considerable training. In general, their conclusions were that:

- the procedures provide a legitimate, objective and consistent method for analyzing workplace literacy tasks;
- the matrix of materials and uses is appropriate, easy to follow, and comprehensive; and
- the scales appear complete and comprehensive, but complex.

This complexity implied that the scales (particularly those used for assessing reading and writing tasks) as they were then defined might be most appropriate for research purposes unless users were carefully trained and points on the scales were anchored to examples of job tasks familiar to the raters. We revised the scales to include fewer points and developed more concrete definitions and anchor points. As our team of field observers worked with the rating procedures and used the data collected from observations of literacy tasks in the workplace, we became increasingly competent with our ratings and confident that others could be trained to use them effectively.

Inter-rater Agreement

Inter-rater agreement was assessed by training three raters and assigning them the task of rating the most difficult literacy tasks from every site and job observed, 41 literacy tasks in all. These tasks were selected because they covered the range of jobs observed, represented the full range of literacy difficulty levels observed, and were those tasks most comprehensively described. All the raters observed jobs at two or more sites, but none of the raters had been at all the job sites. Thus, the tasks had to be described in a fashion which would allow raters with no first-hand experience of the site to understand the job components.

Inter-rater agreement was evaluated by assessing the degree of agreement between pairs of raters, and amongst the three raters. In each case, the criteria for determining agreement were the same: was the rating made by each rater located on the same scale, and did the raters agree on the level of difficulty within one point on the selected scale. Tables 8 and 9 below reveal the levels of inter-rater agreement.

In no instance did the raters disagree on the scale to be used, although in two cases, raters did disagree on the sub-scale to be used within the prose scale. This resulted in low agreement on that scale (.56). This was, in fact, the scale which was least often appropriate to the literacy tasks we observed, and so was the one with which the raters were least familiar. In no instance, on the other hand, did the raters disagree on the rating of a job task on the quantitative scale.

Table 8 describes the rates of agreement between three pairs of raters assessing a total of 41 literacy tasks. Average inter-rater agreement across all scales was .85, ranging from complete agreement on the quantitative scale to .56 on the prose scale. Table 9 depicts agreement amongst all three raters. At this higher standard, the raters were able to reach agreement on 30 of the 41 tasks, for an average of .73.

TABLE 8: AGREEMENT BETWEEN THREE PAIRS OF RATERS

Scale	Total No. of Tasks Assessed	Average Agreement	Pair 1 Agreement	Pair 2 Agreement	Pair 3 Agreement
Document	22	.80	.77	.77	.86
Quantitative	6	1.00	1.00	1.00	1.00
Prose	3	.56	.33	1.00	.33
Oral	10	.93	.90	1.00	
TOTAL	**41**	**.85**	**.80**	**.85**	**.88**

TABLE 9: LEVEL OF AGREEMENT AMONGST ALL THREE RATERS

Scale	Number of Tasks With Agreement	Agreement Amongst All Raters
Document	14	.64
Quantitative	6	1.00
Prose	1	.33
Oral	9	.90
TOTAL	30	.73

Readability Analysis

The procedures described above discriminated between jobs in a manner not apparent in readability analysis of the reading grade levels of longer documents used in the workplace. All longer documents related to the jobs assessed in this study (including employee handbooks and training materials) were collected during on-site observations. Whenever they contained enough text, we analyzed them for their readability using the FORECAST readability formula. This formula was developed by Sticht (Drew and Mikulecky, 1988) specifically for analyzing job-related reading materials. The results are in Table 10.

TABLE 10: READABILITY ANALYSIS OF WORKPLACE DOCUMENTS

Site	Item	Mean Grade Level
Manufacturing A	Flexible Benefits Program	12.4
	Savings Plan	11.7
	Wilderness Survival Training	10.1
	Materials Data Safety Sheet	14.5
	The MSDS - Your Guide to Chemical Safety	10.8
	Quality Circles Materials	10.6
Manufacturing B	Safety Measure	9.6
	Employee Reference Manual	12.2
Manufacturing C	Health Insurance Booklet	12.2
	Group Insurance Plan	11.4
	Technical Pay for Performance	8.9
Hospital A	Policy and Procedures	11.5
Hospital B	What's Happening	10.7
	Employee Handbook	12.1
	Chemical Hazard Communication Program	12.3
Hospital C	New Employee Orientation	11.8
	Employee Handbook	11.0
	Blood Drawing and Handling Procedures	9.3
	Bone Marrow Procedures	10.9

When questioned, supervisors reported that few, if any, of the documents supplied to us were required reading. Those used in training sessions were often read aloud to workers if the material had to be used immediately. Sites provided training on the use of hazardous materials in the workplace; videos or films to promote safe workplace practices often accompanied this training. Other written materials such as employee handbooks could be taken off site and interpreted by someone else if the worker found this necessary.

In nearly all cases, such ancillary reading materials proved to be poor predictors of the difficulty level of literacy requirements for entry-level jobs studied. Manufacturing Sites A and C provide striking examples of this poor predictive quality of ancillary reading material. At Manufacturing Site A, entry-level job literacy requirements placed at the lowest difficulty level on our scales of all jobs studied. Yet the reading level of manuals and training materials ranged from 10th to above 14th grade level. Had the company based its estimates of literacy requirements for entry-level jobs at its plant on readability analysis, it would have required a high school to college diploma of workers whose day-to-day job literacy tasks could probably be done by most of the adult population.

Manufacturing Site C's entry-level workers performed job literacy tasks at the highest level on our rating scales. Several ancillary documents at that site were at 11th to 12th grade level. However, the Pay for Performance Manual (a reference used by workers in preparing for certification as core operators) was written at grade 8.9 level. This seemed congruent with the difficulty level of the job. Team training materials were also adapted to the reading level of workers, with some exercises being translated into the Southeast Asian languages spoken by some of the workers being trained.

Hospital site ancillary reading materials ranged in difficulty level from 9th to 12th grade level. Yet most hospital sites did not require a high school diploma of entry level workers. Lab assistants at Hospital C read blood drawing and bone marrow procedures for reference. These were written on a 9th and 10th grade level. Since lab assistants were required to have previous experience with such procedures or post high school science course work, reading materials likely to be read by workers were quite in keeping with the difficulty level of the job (mid range on our scales) and the requisite job requirements.

As we have already discussed, most of the reading materials used by workers on the job do not have sufficient text to be evaluated by a readability formula, and as can be seen from the examples cited, most of the materials provided for analysis were ancillary to the actual job and poor predictors of job difficulty level. In cases where there was a closer match between job difficulty level and a specific document, it was more likely that workers actually referred to the reading material in the course of their jobs.

Implications for Further Study

There are a number of unresolved issues deserving further attention.

(1) The creators of the NAEP Assessment of Young Adult Literacy created a series of anchors along the NAEP reading scale at points where 80 percent or more of the respondents who were at that point were able to answer that question correctly, while less than 50 percent of those at the next lower level answered it correctly. The definition of accuracy on that test battery is easy to arrive at. Accuracy on the job is often less easy to define and most work situations require a much higher degree of accuracy than 80 percent, although the precise requirement varies. Laboratory assistants, for instance, dealing with test results on which lives may depend, are expected to work to a very high degree of accuracy. The industrial sites we observed aimed for zero defects which they defined as products falling within an acceptable range of accuracy.

(2) It has not been possible to test the extent to which the job tasks are of equal difficulty to similar (because they contain similar elements) test items on the NAEP. Nor was it possible within the confines of this study to test the literacy skills of workers performing each job to determine where they fell on the NAEP scale. Sticht (1975), for instance, reports that

workers are able to perform work literacy tasks approximately two reading grade levels higher than their personal reading levels.

(3) It is also desirable to distinguish between a test item seen only once and a job task of similar difficulty that is completed daily or several times a day. Assuming that our rating procedures relate job tasks to test items accurately, the degree to which this predicts the percentage of the population able to perform that task with a minimum of training could not be assessed within the bounds of this study.

V. FINDINGS CONCERNING LITERACY LEVELS

In this chapter, we discuss the findings resulting from our analysis of the data collected at three manufacturing sites and three hospital sites during the field study of entry-level jobs. We observed seven entry-level positions within six companies. There are obvious limitations to the generalizability of findings from a study of such small scope. Yet, the varying context of the workplaces visited and the resulting differences in the literacy level of the entry-level jobs studied raises questions about how effectively job literacy requirements can or should be considered independently of the particular environments in which work is performed. Many interrelated factors from both outside and within the workplace were found to influence the job literacy requirements of entry-level employees at the sites studied. These context variables included the following:

- nature of the local labor market, the available applicant pool, and the salary levels of workers;
- marketplace conditions and the nature of the industry itself, its product(s) and technology;
- current trends in management philosophy and practices;
- size and organization of the company and the work, the overall climate, requirements and regulations, pace and volume of work; and
- nature and extent of change taking place within a given company.

Context Variables and Job Literacy Tasks

Different, sometimes subtle, combinations of context variables influence the way lab assistant, factory worker, and dietary aide positions are designed and carried out, as can be inferred from the descriptions of the study sites provided in Appendix A. Similarly, how the differing context of each workplace was found to influence job literacy levels is briefly discussed in this section and is summarized in Table 11 below.

TABLE 11: RATINGS OF MOST DIFFICULT LITERACY TASKS FOR ALL JOBS STUDI

	READING (Scale of 7)	WRITING (Scale of 7)	COMPUTATION (Scale of 6)
MANUFACTURING			
Assembler (A)	1	1	None
Packer (A)	2	2	1
Inspector/Packer (B)	5	5	3
Tender/Helper (B)	1	1	1
Core Operator (C)	6	6	6
HOSPITAL			
Nutrition Assistant (A)	7	7	6
Nutrition Assistant (C)	5	6	2
Dietary Aide (B)	4	5	4
Dietary Aide (C)	2	2	2
Laboratory Assistant (A)	7	7	2
Laboratory Assistant (B)	6	6	3
Laboratory Assistant (C)	6	5	4

The following examples are not intended as evenly detailed portraits of the six study sites; rather, for the sake of brevity, we have drawn from whichever site(s) best illustrated the context feature at hand. Because "context" itself means the interrelated conditions within which something exists or occurs, these examples reflect the influence of multiple variables, even though for heuristic purposes we have attempted to address some of them discretely.

Labor Market, Applicant Pool, and Salary Levels

Hospital Sites A and B and Manufacturing Sites A, B, and C all were located in New England, a geographical region characterized by low unemployment. Hospital Site C was located on the West Coast in an area that enjoyed an ample supply of entry-level workers.

Hospital Site A reported that it had a well-qualified entry-level applicant pool despite a relatively tight local labor market. It attributed this success to its national reputation, to its community prominence as a desirable employer (pay scale, benefits, labor-management relations, location, physical surroundings), and to its great size. While the hospital preferred to hire laboratory assistants who have had previous medical training (several proprietary schools and community colleges in the area offered six-month to two-year programs in various medical support areas), this applicant pool had so dwindled that from time to time candidates with no previous specialized training and little or no prior work experience had also been hired. Because the lab's experience with these newly hired workers had been so positive, the definition of a "well-qualified" applicant had broadened, and Hospital Site A's lab had thus been able to keep in step with local labor market conditions.

Similarly, the Department of Dietetics at Hospital Site A had considerably upgraded the role of nutrition assistant to include a number of tasks previously done only by dietitians. Such tasks as calculating patient input-output (I + O) data, monitoring special dietary requirements, and calculating caloric intake were now done by the nutrition assistants under careful supervision of the dietitians to whom they were assigned. It seemed likely that the decrease in time consuming paperwork for the dietitians enabled Hospital Site A to increase the number of patients served by a dietitian, thus saving on labor costs. The nutrition assistant's job was defined as an entry-level position; workers we observed had formerly been dietary aides, store clerks, or fast foods restaurant workers.

Hospital Site B had accommodated to an especially tight local labor market by imaginative hiring practices: Of the three lab assistants observed in this study, one had been promoted to the lab after nine years of work in the kitchen, another had previously been a regional manager for a rental company, and the third's background was in early childhood education. Like Hospital Site A, the lab's accommodation to local labor market conditions had been successful, though the dietary department had not fared as well. Dietary managers reported that labor shortages had forced them to hire individuals whom they ordinarily would have considered unqualified. As a result, the dietary aide position had been broken down into a number of discrete and repetitive job tasks performed by the same worker. Attempts at training these marginal new workers in the personal management skills necessary to perform the job satisfactorily had produced only mixed results. The personnel department said that many workers had caved in to the stress of demands for punctuality, cleanliness, and accuracy in performing job tasks or had become bored with the repetitive nature of their jobs and had moved down the street to work in fast foods restaurants where it was reported they had repeated the cycle. In contrast to Hospital Site B, the dietary department at Hospital Site C had required that all entry level dietary aides be trained to work all positions in the department and had held frequent brief staff meetings to involve them in problem solving.

Hospital Site C was located in an area where labor market conditions were much more fluid. The labor pool, which was indicative of the region's great ethnic diversity, contained high numbers of new immigrants seeking jobs and opportunities to better their lives. In the dietary department, this was seen in the Hispanic, Chinese, Jamaican, African, African-American, and Anglo staffing mix. Similarly, the lab was staffed by recent and not-so-recent immigrants from Spain, China, the Philippines, and Honduras. Such diversity was valued by the hospital. In serving a multicultural population, the hospital needed employees who could readily relate to patients and who could serve as bilingual translators for doctors, nurses, and other medical staff at a moment's notice. (For example, two of the lab assistants who were Spanish-speaking, the largest ethnic group among the hospital's clientele, were officially designated as translators and received extra pay for their on-call services.)

Finding experienced lab assistants had been less difficult than retaining them once they had learned the job. While some lab assistants were trained in their native countries, others had acquired their training on the job. The supervisor of the lab reported that there was a fairly high turnover rate among lab assistants as they sought higher wages at other hospitals.

Notwithstanding the greater than optimal turnover, the lab assistant position at Hospital Site C had been expanded to include many tasks traditionally reserved for higher-ranking employees with more experienced and education. In this instance, lab assistants had assumed many of the specimen-handling tasks lab technicians and medical technologists (who held two- and four-year degrees, respectively, and were paid more) performed in larger hospitals. Such an expansion of responsibilities, of course, hinged upon the literacy skills, learning abilities, and technical competencies of lab workers. In rating the reading, analyzing, speaking, and calculating skills utilized on the job, we found them to require higher quantitative skills and similarly higher document reading levels than those of the lab assistants at Hospital Sites A and B.

Unlike Hospital Sites A and B, Hospital Site C required that lab assistants have had on-the-job lab training in their prior places of employment or relevant college level science coursework. Thanks to the availability of lab assistants with previous experience, all recently hired lab assistants had prior hospital laboratory experience.

The local labor markets were extremely tight for Manufacturing Sites A, B, and C, all of which reported having difficulty in attracting suitable applicant pools. Sites A and C were located in rural areas, and Site B was in a small, primarily blue-collar city. In all cases, the base rate for the manufacturing jobs observed in this study was under $10 per hour; vacation, health care, and other fringe benefits seemed quite comparable (though Site C provided an on-site daycare facility). Managers at all three sites emphasized how they simply had to make do with whomever they could attract and that the applicant pool was far too limited to allow them the luxury of hiring only those who could read, write, and compute well. Although substantial numbers of immigrants and low-skilled workers could be found within the communities of Sites B and C, as well as within a 30-mile commute from Site A, only Site C had been successful in utilizing limited-English-proficient workers. Why this was true was quite puzzling (especially since, as soon became evident, workers at Site C were required to utilize far greater literacy-related skills than at the other two factories), but it undoubtedly had more to do with each company's hiring history, corporate culture, lack of recruitment efforts among immigrant organizations, and related factors than with the actual literacy requirements of the jobs themselves.

The entry-level positions we observed at the three manufacturing sites were manual-labor production jobs. Good health, physical stamina, and manual dexterity were essential prerequisites. Unlike the ways in which we found literacy requirements could be circumvented by those workers lacking minimal competencies, the physical requirements were substantial and incontrovertible, given the technology present in the three factories.

Literacy skills of both the limited applicant pool and existing employees had become the focus of concern at these three sites only relatively recently, as each of the companies had begun examining its position in the highly competitive marketplace and had attempted to implement preeminent human resource management practices espoused in top U.S. management circles. In the next subsection we will discuss the effects of these practices on the literacy requirements of entry level jobs.

Marketplace Conditions, Industry Type, and Management Practices

Although Manufacturing Sites A, B, and C had diversified product lines, all the entry-level jobs observed in this study were within the automotive divisions of the three companies. As suppliers to U.S. automakers, these small to mid-sized companies resembled the technology-driven, labor intensive environments of the Big Three's assembly plants. The assemblers studied at Manufacturing Site A, for example, worked at a sub-assembly station located at the end of a linear conveyor line; the kind of equipment utilized and the organization of work along the line were traditional auto assembly methods. Production processes at Site B, given the enormous sizes and fairly automated operations of non-woven carpet-making machines, were organized in large semi-circular fashion and staffed by small work units of two to three persons each. At Site C, each production line formed an elongated oblong whose outer perimeter was lined with noisy, modestly-sized machines which workers used to cut, mold, and rivet extruded rubber channels for car windows. Again, the emphasis here was on the formative role played by the kinds of machines and technology necessary for production processes and by the industry-wide influences that accompany production lines.

However, Manufacturing Sites A, B, and C had more in common with the Big Three than technical systems. Their social systems shared essential characteristics: among the hourly workers, there was a perceived decline in work ethics (motivation, pride of craft, work attendance, self-discipline) and an unevenness of educational preparation; among managers, there was a major re-focusing on competitiveness, productivity, and progressive human resource management practices.

Moreover, just as the Big Three face a highly competitive marketplace, so do their suppliers. As automakers move towards sole sourcing (one supplier for a component, as opposed to the multiple supplier "safety-net" mandated by previous policy), U.S. suppliers face increasingly keen competition among each other and against potential low-cost, off-shore sources. Indeed, each of the three suppliers in this study has firmly tied its auto-related production to the product lines of a single automaker; two of the three sites are designated sole-sourcers for particular components of specific makes and models of its Big Three customer.

Having sketched the common sociotechnical foundations and marketplace realities of the U.S. auto industry and the three manufacturing sites observed in this study, we can now move to considering concrete examples of how those common foundations affect job literacy requirements of entry-level employees. Throughout the sections that follow, we will be referring to findings presented in Table 11 on page 137 of this chapter.

Manufacturing Site A, where an estimated 40 percent of the hourly workers had not completed high school, employed a mature workforce whose average age was approximately 40; as many as one-fourth of all workers had been there for 20 years or more. Here the literacy skills required for these jobs were at the low end of our rating scales. It is likely that most of the population would be able to perform the assembler and packer jobs without further skills development.

However, in an attempt to keep pace with competitive marketplace pressures and current management trends, Manufacturing Site A had initiated a somewhat sophisticated quality-improvement training program based on the teachings of a nationally-recognized management consultant. Some one-third of all workers were then involved in worker groups, led by a supervisor, which met weekly or biweekly to focus on production-related problem-solving. Such teams required that workers participate in identifying, analyzing, and resolving technical problems. This involved speaking and listening, analyzing the problem and people's views, reading flip-chart or board materials, assisting in researching the problem further if necessary, and taking turns writing minutes of the meetings. Yet we found the literacy-related skills required for full participation in the teams were at a far higher level than the skills required to successfully complete the production tasks that until now had comprised the sole content of entry-level jobs. Day-to-day literacy job tasks were at the bottom of our rating scales; team participation required prose reading and writing tasks at the highest point on the scales. Since both managers and workers indicated that literacy skill deficiencies were greatest among the older, most experienced workers, presumably even fewer of the senior workforce could effectively participate in such teams. Top plant managers, however, were committed to the training, seeing it as essential to maintaining the company's competitiveness. To paraphrase their concern, the "conceptual difficulties" posed by workers' existing literacy limitations had to be overcome; solutions had to be found, for there was no additional pool of better educated workers from which this company could draw.

At Manufacturing Site B, we found that performance estimates for workers approximated those found at Site A if the latter's team skills were not taken into consideration. The inspector/packer job was slightly more complex, largely due to inconsistencies in the way information needed to fill out forms was provided. "Progressive" philosophies of doing business (e.g., Site A's quality teams) were not evident at Site B, though managers reported that a limited level of employee involvement in "venture" groups were underway. (From posted documents, it would appear that these groups were little more than narrowly-focused task forces aimed primarily at trimming costs in areas such as waste, packaging, and shipping.) Because none of the workers whom we interviewed were venture members and membership was both voluntary and uncommon, we did not consider the reading, writing, listening, speaking, and analyzing skills utilized by members as literacy skills necessary to the entry-level jobs we analyzed at this site.

At Manufacturing Site C, the core operator position (similar to that of the operator assisted by site B's tender/helper) required literacy tasks at the mid to high level of our scales. Here we witnessed much of the Big Three's management agenda in progress: work was organized in self-regulating teams or work cells; push-pull technology had replaced conveyor-belt production/ assembly methods; and manual tasks were accompanied by responsibilities for quality control (SPC), machine maintenance, production and manpower scheduling, and various other tasks atypically expected of entry-level employees in traditional manufacturing environments. (This organization of work is more fully described below.) Yet managers at Site C estimated that as many as 25-30 percent of all hourly workers lacked the equivalent of a high school diploma.

The hospital industry is not entirely dissimilar from manufacturing, either in terms of management's current agenda or the complexities of today's marketplace challenges. Faced with skyrocketing costs of sophisticated medical procedures and instrumentation, an aging population that suffers from costly long-term illnesses (e.g., cancer, heart disease, AIDS), and serious deficiencies in patients' health insurance coverage, hospital administrators are increasingly having to make choices, to define and narrow their markets, to close out entire departments or to merge with larger hospitals. Within all three hospital sites studied, we encountered policies and procedures aimed at cost-containment and at improving the quality, efficiency, and patient-focus of health care delivery. Through interviews and observations, we witnessed a profound concern with the well-being of HIV patients, sensitive and sensible precautionary procedures related to the care and testing of all patients, close attention to patients' confidentiality rights, and a serious commitment to superior health care delivery by the entry-level employees with whom we interacted. Advanced technology--including computerized information systems, new testing and treatment procedures, and sophisticated diagnostic instrumentation -- was present everywhere in the various hospital departments.

At Hospital Site C, a 125 bed county hospital, marketplace pressures were keenly felt. The hospital waged an uphill struggle to operate within the confines of its budget, in essence serving as the facility of last resort for patients with costly long-term ailments whose insurance had run out and as the primary care facility for low-income ethnic populations, many of whom had little or no insurance coverage.

Earlier we described how, partly as a cost-containment measure, the lab assistant's position at Hospital Site C had been expanded to include many of the tasks ordinarily performed by better trained, higher paid laboratory technicians, medical technologists, and phlebotomists. While this would probably not have been possible without an ample labor pool of experienced lab assistants in the region, it also required the kind of technology that could make such an expansion of responsibilities feasible. Careful investment in automated testing instruments and commercial test kits enabled the lab assistants to perform many preliminary and routine tests at the same level of reliability any licensed medical technologist would have. With these state-of-the-art instruments, lab assistants' literacy-related tasks had also expanded, placing great importance on the reading and interpretation of numerical data and histograms, analyzing whether results were within normal limits, detecting any inconsistencies of data that warranted immediate attention of the supervising medical technologist, and understanding the basic statistical concepts necessary for calibrating the instrument and running quality control checks.

Organize, Size and Volume of Work

The size and organizational structure of the company, the organization of work; the overall climate of the workplace, regulatory standards and product requirements, the volume and pace of work also influenced the literacy requirements of the jobs studied. Hospital Site A was a nationally prominent research institution that employed some 10,000 people and provided care for 1082 beds as well as extensive outpatient services and neighborhood clinics. Its chemistry lab employed some 77 people, 10-13 of whom were lab assistants, one of the two entry-level positions observed at that site. The volume of work in the lab was impressive, with over 1500 test requisitions being processed daily and each requisition could call for many different tests. Work was intense, with concentration required of lab assistants as much as 85 percent of their work time. Exactitude and uniformity of procedures were essential, inasmuch as employees rotated job tasks. Work was organized around five "tables" or workstations, each of which was staffed by two or three lab assistants. At the various stations, specimens were received for testing, assigned a computer accession number, logged into the computerized lab information system, centrifuged, decanted into tubes that were actually used for testing, and passed on to the appropriate med techs who either performed the actual testing or, if necessary, sent specimens to an outside lab. Test results were also provided, both by telephone and by computer printout, to the originating departments.

Thus, lab assistants at Hospital Site A were expected to: (a) focus on their tasks for long periods of time and under considerable pressure; (b) memorize and perform detailed specimen preparation procedures for over 150 tests, keeping up with an ever-expanding list of tests and constantly-evolving testing requirements and adhering to strict precautionary rules for safe specimen handling; (c) understand the limits of their own knowledge and training and raise questions immediately upon suspicion that something differed from the expected norm; and (d) be able to interact well and in close proximity with many kinds of people. Overall, the climate of the lab was characterized by high professionalism and cooperative teamwork and by lab assistants quietly pitching in to help each other keep pace with the workload. Supervision was minimal, with one medical technologist and the lab's manager serving primarily as problem-solvers and testing experts. Despite the highly structured nature of this lab, which was clearly necessitated by the great volume of tests that were conducted in a very short turn-around time, a team concept had developed naturally. This contributed to a work environment in which each lab assistant had been able to learn the complex procedures that accompanied all the job tasks.

A recent decision at Hospital Site A to further upgrade the state-of-the-art equipment and MIS system in the chemistry lab will substantially reduce the number of chemistry lab tests being sent to outside labs. Conducting the additional tests in-house will result in decreased lab charges to patients; it will also increase the timeliness and reliability of reporting test results and thereby provide better health services to its patients. The additional tests will also further expand the repertoire of test procedures that lab assistants must know and perform daily.

By way of comparison, Hospital Site C's central lab had a total staff of 28 full time employees (FTEs) and provided chemistry, hematology, bacteriology, microbiology, blood bank, and phlebotomy services to all wards of the 125 bed hospital, including the emergency room, jail ward, and morgue; to a sizeable outpatient population; to an affiliated rehab center; and to a couple of small clinics located in extremely poor neighborhoods. With only three lab assistants, all central lab staff, including the lab assistants, were expected to "wear different hats."

Unlike the lab assistants at Hospital Sites A or B, lab assistants at Hospital Site C played a prominent role in the processing of routine tests, working alongside and/or under the close supervision and sign-off of licensed med techs. In addition, the lab assistants received on-the-job training and official certification in venipuncture, and had primary responsibility for all phlebotomy services--again, with close oversight of the supervising med tech. Because the workload of the lab was highly variable (i.e., some days there were few tests to run, other days there were many), using lab assistants to meet the varying needs of the wards and outpatient clinics for blood drawing and training them to assist med techs in the conducting of routine tests was an extremely cost-effective approach to manpower utilization. More relevant to the purposes of this study, this approach also maximized the potential of entry-level employees to contribute to the organization; it stretched their learning capacities and built upon their literacy skills. Daily these lab assistants needed to read, understand, and perform various testing procedures; daily they needed to calculate ratios and understand basic descriptive statistics; and daily they needed to listen attentively and speak confidently, persuasively, and informatively to patients and medical personnel. Literacy requirements of hospital laboratory assistants are shown in Figures 8 and 9 on page 97.

Such job expansion at Hospital Site C was well supported by continual on-the-job training by supervisory medical technologists who were not personally threatened by the sharing of knowledge and responsibilities with entry-level lab assistants. Interestingly enough, this degree of flexibility and cooperation met with full approval of the collective bargaining units present at the hospital. Yet the expanded role of lab assistants at Hospital Site C raised the literacy stakes. In this hospital setting, employee accuracy in performing the literacy-related job tasks was essential.

As has been discussed in the previous section, the organizational structure of the company shapes job literacy tasks at manufacturing sites as well. Where traditional assembly line manufactur- ing is in place, entry level jobs require few literacy tasks of workers and those that are required are of a very low level. Once statistical process control tasks are required of entry-level workers, or if workers are required to become involved in troubleshooting as members of problem solving teams, literacy requirements are raised drastically. In the context of Manufacturing Site A, this presented serious problems for management because they were requiring high literacy levels of workers one hour a week, while their day-to-day job performance required only simple literacy tasks or none at all. The result was low worker morale and high worker resistance to participating in team activities.

At Manufacturing Site C, where work was organized around a team concept, worker pay for performance certification had been implemented, and worker morale was high. The day-to-day literacy requirements were also high (See Table 12, p. 151.), but since they were an integral part of the job, most workers were able to perform them effectively either independently or with assistance from other members of the team. Thus the high literacy demands of SPC or quality control charts did not present a threat to workers in this context.

TABLE 12: MOST DIFFICULT LITERACY TASKS FOR ENTRY-LEVEL LIGHT MANUFACTURING WORKE

	READING (Scale of 7)	WRITING (Scale of 7)	COMPUTATION (Scale of 6)
Assembler A	1	1	None
Packer (A)	2	2	1
Inspector/Packer (B)	5	5	3
Tender/Helper (B)	1	1	1
Core Operator (C)	6	6	6

Nature and Extent of Change Within Company

Much of our previous discussion has depicted the changing context of work and the concomitant changes in literacy-related job tasks and employers' expectations of what constitutes a competent entry-level worker. Let us now focus on two jobs at two sites: the lab assistant at Hospital Site C and the core operator at Manufacturing Site C. These two jobs and work environments, we believe, offer an example of change in the workplace and how that change both affects and depends upon workers' literacy skills.

At both Hospital Site C and Manufacturing Site C, the enlightened management of human resources and new technology had sharply increased the literacy requirements for entry-level personnel to meet the challenges of a highly competitive marketplace. As recently as five years ago, the lab assistant and factory worker jobs at these two sites were substantially less complex, but breadth of responsibility and depth of required skills/knowledge had now been added to both positions. At both sites, entry-level employees were now expected to function across all categories and subcategories of Bloom's taxonomy; knowledge, comprehension, application, analysis, synthesis, and evaluation were all cognitive skills essential to job performance. Neither the lab nor the factory could have operated at such a level of efficiency (or striven to do even better in the future) if lesser-skilled workers had been the mainstay of their operations.

Given that it was a small hospital and it had an efficient lab, Hospital Site C's use of lab assistants to meet the varying needs of its wards and clinics for blood drawing was probably not an uncommon approach to cost-effective manpower utilization; the same was true of their use of assistants to assist med techs. And given the focus within management circles on the successes wrought by Japanese teamwork and statistical process control, the decision by Manufacturing Site C to redesign its workplace along those lines so as to better compete in today's tough industrial marketplace hardly constituted a radical innovation; if these changes had negatively affected the bottom line, they could easily have been rescinded.

What distinguishes these two work sites was their concerted effort to maximize the potential of entry-level employees to contribute meaningfully to the organization. At both sites, this has required management's commitment to the ongoing development of lab assistants' and core operators' knowledge and skills through extensive on-the-job training. And it has meant a new kind of supervision: coaching, teaching, mentoring, modeling, and providing expertise and feedback when necessary. It has also entailed a belief, among both managers and workers, that new technology can and should be utilized to enhance entry-level jobs, not to replace them or to de-skill the workforce. There is another observation about the changing context of work that must be made. At all three hospitals we observed, the lab assistants kept up with change; on a daily basis they were consciously engaged in developing their own skills, assimilating whatever facts, procedures, and behaviors were necessary to successfully cope with the ever-changing testing requirements, automated instrumentation, and patient populations. These lab assistants expressed personal satisfaction at learning new things, at the opportunity to "grow" as the requirements of their jobs and expectations of their employers continued to expand. They also believed they were doing important work. To quote one lab assistant, "We save lives." In the factories, worker satisfaction with change was less evident.

Certainly the widely varying contexts of these six work sites we observed and the significant disparity of literacy skill requirements (for example, between core operators at Manufacturing Site C and the tender/helper at Site B) seem to call into question the use of standard industrial and job classifications (such as those provided by SIC codes and D.O.T. categories). New, more useful schema for classification appear to be needed. Whether fruitful approaches can be found within the technology push/pull arena or elsewhere is, of course, beyond the scope of this study.

Having illustrated the effects of the climate of the workplace upon the definition and literacy requirements of jobs, we now turn to a more specific discussion of our findings concerning literacy requirements of entry level manufacturing jobs.

Literacy Requirements of Entry-Level Manufacturing Jobs

The manufacturing sites observed, as was discussed earlier, included one traditional assembly line plant, one transitional manufacturing site, and one workplace in which pay for performance and the team approach had been implemented for several years. Appendix A contains site portrayals describing each of these sites in more detail. Entry level jobs studied were assemblers, packers, and machine operator assistants. The level of literacy required for these jobs was relatively low, but varied according to the type of manufacturing environment. The operational definition of workplace literacy used in this study bears repeating here:

workplace literacy is the integrated use of reading, writing, mathematics, listening, speaking, and related cognitive skills to perform job-related tasks. This often requires the application of prior experience.

In this section we will discuss the nature of the literacy skills required in entry-level manufacturing jobs and the most difficult requirements for each job at each site. We will then compare the requirements for similar jobs across sites and discuss the new skills needed in the next job up on the promotion track.

Rating scales for prose (PR) comprehension are found in Table 2, p. 114; those for document (DOC) reading and writing task scales are found in Table 3, p. 114; and those for quantitative (QUAN) tasks are shown in Table 4, p. 116. The oral language (OL) scale, in Table 5, p. 116, is less specific, and consists of three categories that broadly correspond to the purpose of the speaker. The oral language scale assumes that persuasive speaking requires higher oral language skill than does narrative speaking and that providing simple information requires the least amount of oral language proficiency.

The Matrix of Materials and Uses (Table 7, p. 122, Chapter IV) is used to determine the number of job literacy tasks and then to place each set of materials on the matrix according to how the worker used the materials.

Nature of Job Literacy Skills Required

Most entry-level manufacturing job literacy tasks varied from simply writing or copying one or two features of information on a tag or label to filling out a checklist based on a visual inspection of a work area. Computation skills more often entailed simple addition and subtraction. Many of these tasks were accomplished through estimating amounts or weighing commodities. This level of quantitative skill can by accomplished by most of the population.

Statistical process control (SPC) tasks were of a higher level, involving multiplication and division with subsequent data entry. Yet the quantitative skill requirements of the SPC tasks we observed were made manageable for entry level workers by being broken down into carefully specified steps and procedures and using well-defined SPC forms. (See Table 12, p. 151.)

Wherever computation was required in the workplaces we visited, calculators were used. Furthermore, the amount of interpretation and analysis of quantitative data was kept to a minimum for entry-level workers. At Manufacturing Site B where product quality specifications involved the weight of a roll of fabric of given length, the tender/assistant was required only to report the weight to the operator. The operator determined how to evaluate and present the information. At Site C, when parts were out of "spec," if a simple solution were not obvious, the troubleshooter was called upon to help analyze the problem and recommend corrective action to the supervisor or to the team.

The most difficult job literacy tasks usually entailed computer data entry or the use of forms that required gathering several features of information from a number of sources. These document reading and writing tasks required additional training and procedural knowledge. Where computer data entry was used, menu-driven software was employed. Data entry tasks entailed applying knowledge of job procedures and working with several features of information, often with more than one exemplar to choose from in identifying the correct information. Accuracy was important in these jobs since quality and efficiency, and thus cost control issues, were involved. Higher literacy skills were required in sites where training in team work skills, quality control, SPC or problem solving were required.

The Most Difficult Job Literacy Tasks at Each Site

Manufacturing Site A

At Manufacturing Site A, we examined the literacy requirements for assemblers and packers of automobile instrument panels. Assemblers inserted and snapped into place hard plastic heater and radio speaker ducts, and riveted or power screwed manufacturer scripts and other instrument panel parts into place. Packers received and sorted instrument panels and packed them into boxes with protective shipping materials, labeling them appropriately for shipping.

The fundamental job literacy tasks for the two jobs observed at Manufacturing Site A were not substantially different in difficulty level from those at Manufacturing Site B. Like the tender/helper at Manufacturing Site B, the assembler at this site was required only to match one or two features on identical tags (DOC 1). The job required no measuring and had fewer literacy opportunity tasks than did the tender's job. The one opportunity task observed was seen only on the first shift, where quality control had asked assemblers to save every script that broke while being screwed into place. At the end of the shift, they were asked to count up the number of broken scripts and write the date and total on a scrap of paper (DOC 1, QUAN 1).

Assemblers were recorded as having six literacy tasks requiring interaction with materials in the course of their job. Only two of these tasks were directly related to the work itself. The others were connected with circles or teamwork training activities.

Manufacturing Site A's packers, like those at Manufacturing Site B, were required to perform only limited reading and writing tasks. In this case, the packer applied a knowledge of the job tasks to an inspection of the area at the start of the shift. He was then required to ascertain whether each task listed had been completed during the previous shift, entering a check mark in the appropriate space on the form. This task required step-by-step inspection of the work area and entering results on a checklist. It was rated DOC 2, a considerably less difficult task than the inspector/packer's most difficult task at Manufacturing Site B, which involved the application of non-standardized formats to feature matches. (See Table 12.) Analysis of the uses to which packers put reading materials showed a total of 19 literacy events, nine of which involved reading for specific information, seven entailed interacting with goods (usually counting or weighing tasks) and three used forms or tables.

In addition to the minimal literacy requirements described above, Manufacturing Site A assemblers and packers were required to participate in training for group process skills, most of which consisted of consensus seeking activities. Readability analysis of reading materials used for the exercises placed them at a reading grade level of just about 12th grade. (This was much higher than the 4th to 6th grade level of newspapers and popular magazines.) Reading these exercise materials turned out to be a literacy opportunity rather than a requirement of the job since the trainer read the important points aloud to the group.

Participation in the "quality team" meetings was required, however, and demanded that workers use considerable analytical and oral language skills and that they take a turn at writing meeting minutes and presenting reports. The most difficult writing tasks for the job, then, involved the production of prose which could be defined either as writing several sentences requiring prior knowledge or generating a theme from short text and familiar metaphors, (PR 2b or 2c). Oral language skills required persuading others of a point of view (OL3) as compared to the simple language requirements for assembling and packing products, involving merely imparting factual information (OL1). As was discussed earlier, this discrepancy between the low level literacy requirements of the job and the relatively high levels required once a week in team meetings was the cause of considerable anxiety and sometimes aroused hostility in even long term and successful workers. One assembler reported that her co-worker had resisted going to these meetings because she couldn't read and write. However, because of this, she enrolled in Adult Basic Education classes.

Manufacturing Site B

At Manufacturing Site B, we studied the literacy requirements of the tender/helper on a production line manufacturing synthetic automotive carpeting. This entry-level job entailed: assisting the operator by loading the machine feeder with the correct type and color fiber, helping remove finished rolls of fabric, weighing them, wrapping them, and transporting them to shipping. The only document reading tasks involved were on the most basic level, entailing only single feature matches (DOC 1). In one instance, the task involved matching style and number on a tag to the same features on a work order. In another, it entailed copying these same features from the tag to the outside of the packaging (DOC 1). The tender/helper was also required to weigh the finished roll of fabric and report its weight orally to the operator, who then analyzed it to determine whether it met work order specifications. This job entailed a total of six literacy events, three of which applied the use of a label, one gained specific information from forms, and two used a scale.

While the most difficult literacy tasks for the tender/helper at Manufacturing Site B could be performed by most workers and required no additional training, both the operator and the tender/helper reported that good teamwork between them was essential to their work. In a number of non-literacy job tasks, synchronized timing in performing tasks, such as removing full rolls of fabric, was vital. In other tasks, working together to identify the cause of imperfections in the fabric and to correct them was important. While the operator was responsible for operating the machinery and for ensuring the quality of the product, the tender's role as a member of the team was an important one. We rated the most difficult oral language skills for this job as OL 2 because the job involved the ability to narrate problems or information, a level more complex than providing simple factual data.

Because of the importance of good teamwork to this job, management encouraged the tender/helper to learn every aspect of the operator's job. Thus, although the literacy requirements of the job were minimal, there were literacy opportunities here that went far beyond the job requirements of the entry-level position to encompass all the calculation and document reading tasks of the operator's job. As the tender learned the job, he became eligible for promotion when an operator's position opened up. The two experienced tender/helpers we observed said they did not wish to be promoted, however. One said he was too slow at filling out forms and doing calculations, while the other did not want the added responsibility.

The inspector/packer's position required higher document reading skills than did that of the tender/helper. The most difficult task entailed reading the work order, which might be on a computerized form or handwritten by a supervisor -- usually the latter. Two or three features on the work order were used as the basis for implementing appropriate job procedures. As a second step, shipping instructions (two or three features) would be read and carried out. Both tasks required procedural knowledge of the job, putting them at a mid-to high range of difficulty on our scales. (DOC 5) (Figure 4, p. 69.)

The writing task required the inspector/packer to check the computerized customer label to make certain that all features of information required by the work order were listed. If not, the worker had to add the missing information to the label. If there were no computerized label, the worker was required to write a label including all the required features. This task involved a two or more feature match from non-standard formats and prior procedural knowledge (DOC 5), again of mid- to high difficulty.

Quantitative tasks entailed estimating the number of full, sealed boxes that could be stacked on a skid for shipping, keeping in mind a maximum allowable height. While a novice worker might perform a calculation (addition, multiplication, and/or division), an experienced worker would either already know how many boxes could be stacked or would estimate the total. The training level of the task, thus, may be mid-level (QUAN 4), but the actual day to day performance of the task by an experienced worker was probably no higher than QUAN 3.

The inspector/packers operated as a team, with the most experienced worker designated as team leader. Communication skills were seen to be at the level of conveying simple information (OL1) about observed defects to the supervisor. Yet at times, in the absence of the supervisor, such information needed to be conveyed to the die cutter in a constructive, yet firm manner. We found that this required persuasive speaking skills (OL 3) because of the dynamics between the inspector/packers and the die cutters.

This job required 18 literacy tasks: five instances of using labels, two of memos, five of forms, and six utilizing measuring scales of calculators. All literacy materials were used for either application or specific information.

Manufacturing Site C

At the third manufacturing site visited, we observed a group of 10 to 12 workers functioning as a production unit to cut, mold, and glue the rubber parts for the glass window run channels for the door of a particular model of automobile. All workers on the team were either already certified as core operators or were required to be so certified on a pay for performance evaluation after nine months on the job. In contrast to Manufacturing Site B, where having the tender/helper learn the operator's job was desired but not required, at this site it was mandatory. Thus, all workers on this team were required to perform SPC to order materials using computer software and to fill out quality control data charts and the like. Further, in contrast to Manufacturing Sites A and B, all workers were required to participate in team meetings on a weekly basis. Certification in teamwork skills was a prerequisite to being certified as a core operator. Five members of the production team served on a rotating basis as team representatives who reported the team's cost effectiveness, quality control problems, safety performance, and so on at each meeting. The literacy requirements for this site were higher than those for entry level jobs at the other manufacturing sites studied. The most difficult reading tasks for the core operator at Site C involved ordering materials or filling out SPC charts. Both tasks involved four or five feature matches, often with several exemplars, which placed these tasks near the top of the document literacy scale (DOC 6). The most difficult computation tasks were associated with SPC readings and entailed adding together three measurements, then dividing to find the mean. After determining the mean, the results were entered on a graph. This task was rated QUAN 6. Prose tasks required for documenting problems with out of spec parts entailed writing several sentences describing the steps taken to analyze the problem and arrive at a solution (PR 2b). Oral language skills regularly involved narrating information and persuading team mates of a particular point of view (OL 3). Thus, the skills required for this job were at or close to the top of the quantitative, document and oral language scales. The job also required the greatest amount of prose production that we observed at manufacturing sites.

The core operator position involved the highest number of uses of materials of all manufacturing jobs. Most of these were associated with SPC or quality control procedures. There were a total of 54 possible literacy-related job tasks noted. Fourteen of these were associated with SPC measures and the use of calculators, six with SPC graphs, and 20 with the application of forms to job-related tasks. Six others called for reference to directions for ordering materials or carrying out SPC procedures, five referred to writing brief memo-type notations, and three referred to filling out a label or tag.

Interestingly, Manufacturing Site C reported having very few entry level workers unable to successfully pass the pay for performance evaluation. This was the case in spite of the fact that one half of the team we observed were Southeast Asian refugees. The manual for the core operator's job was written about an 8th grade reading level. Team training exercises were more simply written and were also translated into the languages of the foreign-born workers at the site.

Comparison of Literacy Requirements Across Sites

As we have discussed, the level of difficulty of these jobs varied according to the way the jobs were structured. (See Table 12, p. 151.) Even so, the basic requirements of the assembler's position at Manufacturing Site A and the tender's position at Manufacturing Site B were very similar, particularly if the task of writing team meeting notes were excluded. Packers at the two sites were required to perform at about the same level of difficulty on document reading tasks, but the packer at Manufacturing Site B required slightly higher quantitative skills. When we look at the frequency of reading and computational tasks, however, we see that all four of these jobs had very few such literacy events. The core operator position at Manufacturing Site C, on the other hand, involved 10 times as many such tasks as did the least complex entry level manufacturing jobs studied. (See Table 7, p. 122.)

The core operator, being required to do SPC calculations, had much higher computational skills requirements than did any of the other jobs studied. In addition, the document and prose writing tasks entailed analysis beyond what was required to fill in simple forms. Although assisted in the more complex tasks by teammates who had become certified as troubleshooters (next job up the promotional ladder), the core operators were required to pass annual evaluations in performing these tasks.

Requirements of the Next Job Up

We interviewed workers promoted within the entry-level job track at each site. In most instances, these workers had previously worked the position we were observing and had been promoted within the past year. As was mentioned earlier, although the protocol did request that the worker demonstrate these tasks where possible, observers did not gather sufficient documentation to enable us to rate the difficulty level of the job literacy tasks reported as new tasks. The recently promoted packers, assemblers, and tender/helpers at Manufacturing Sites A and B all reported that their new jobs demanded more responsibility on the job, required higher supervisory and leadership skills, involved them more in training new workers, and called for greater teamwork skills.

Promoted packers at both sites and the tender/helper promoted to operator at Manufacturing Site B also reported needing higher quantitative and oral language skills than were needed in the entry-level position. The one exception to this pattern was the promoted assembler at Manufacturing Site A. As utility person, this worker was required to know all the positions on the line and to be able to fill in for any worker there. The worker, however, did not perform more difficult reading, writing, or computation tasks in the course of the job.

The newly qualified troubleshooter at Manufacturing Site C had been through extensive on-the-job training and had taken several courses including rubber manufacture, problem solving and job-related statistics. This worker needed higher computer data entry skills, document skills, quantitative skills, and problem solving skills. The worker also had gained a higher level of knowledge of some job procedures than was needed by the core operator. Carry over skills from the core operator job included teamwork, training, and leadership skills which continued to be applied as a member of the team.

Overall, interviewers reported that there was a considerable difference between the literacy skills required at entry-level and those skills needed for the next job up. This was seen at Manufacturing Sites A and B where quality control and SPC were required of promoted workers. It was also true at Manufacturing Site C where the troubleshooter was given extensive on-the-job training. In general, the level of responsibility and interpersonal skills was higher for workers as they moved up from entry level jobs.

In the next section we will detail the literacy requirements of dietary workers in hospital settings.

Literacy Requirements of Entry-Level Hospital Dietary Workers

The hospital sites visited, as was discussed earlier, varied in size and populations served. One was a large, nationally famous hospital in a metropolitan area, the second a regional hospital in a small Northern New England City, and the third a county hospital in California. Appendix A contains site portrayals that describe each hospital in more detail. We observed nutrition assistants in Hospital Sites A and C, and dietary aides in Hospital Sites B and C. Hospital Site A's entry-level nutrition assistant was called upon to do a number of tasks done by dietitians in other hospitals. Hospital Site B's dietary aide jobs, because of a shortage of qualified workers, were broken down into a number of positions which each involved a few tasks performed repeatedly day after day. Many positions had no literacy requirements at all. We observed those positions involving highest level reading and writing tasks. Hospital Site C's nutrition assistants (called diet clerks) were considered to be on the same level as dietary aides, but had more interaction with patients and were required to do more clerical tasks than other dietary aides.

In this section we will discuss the nature of the literacy skills required of entry level dietary workers and the most difficult requirements for each job at each hospital. We will then discuss the requirements for similar jobs across sites and the new skills needed in the next job up the promotion track.

Nature of Job Literacy Skills Required

Dietary aides assisted in preparation of snacks and trays for patients, delivering trays to patients' rooms, and, at one site, checking and reporting on patient food and liquid intake. This position required minimal document reading skills, for example, checking to make sure the tray included all the items circled on the patient's menu order or snack order. The most complex dietary aide job at Hospital Site B involved matching a feature on the patient's intake/output chart with several possible exemplars on a fluid measures chart and writing in the correct information. This task was done by nutrition assistants at Hospital Site A and by dietitians at Hospital Site C. Most dietary aide computation tasks entailed using calculators or measuring food on a scale.

Nutrition assistants at Hospital Site A had highly clerical jobs which entailed filling in complex forms, often referring to dieticians' reference manuals for information regarding dietary restrictions and for data needed to perform the calculations necessary to monitor patient adherence to special diets. Although calculators were used for the difficult computation tasks, feature matches with many exemplars and complex calculations were entailed in calculating total patient intake from I.V.'s, food, or tube feeding formulas of varying strengths. By contrast, the nutrition assistant at Hospital Site C (diet clerk) did no calculations beyond QUAN 1, although the document reading and writing tasks were of moderately high difficulty. At both hospitals, the nutrition assistants interacted frequently with patients and with both medical staff and kitchen staff. They were required to have excellent interpersonal skills and high listening and speaking skills.

TABLE 13: RATINGS OF MOST DIFFICULT LITERACY TASKS FOR ENTRY-LEVEL HOSPITAL WORKERS

	READING (Scale of 7)	WRITING (Scale of 7)	COMPUTATION (Scale of 6)
Nutrition Assistant (A)	7	7	6
Nutrition Assistant (C)	5	6	2
Dietary Aide (B)	4	5	4
Dietary Aide (C)	2	2	2
Laboratory Assistant (A)	7	7	2
Laboratory Assistant (B)	6	6	3
Laboratory Assistant (C)	6	5	4

The Most Difficult Job Literacy Tasks at Each Site

Hospital Site A, Nutrition Assistant

The nutrition assistant worked in the department of dietetics under the direct supervision of a registered dietician, who checked all of the work. The nutrition assistant was responsible for the patients on three floors of the hospital and was primarily concerned with seeing that the patients' prescribed diets were implemented correctly while providing a selection of foods that would appeal to and be eaten by each patient. At Hospital Site A, the nutrition assistant position was of a higher job classification and pay scale than was the dietary aide job. The position had been upgraded from dietary aide within the past few years. Although it was an entry-level job, on-the-job course work in nutrition was offered periodically in addition to an initial three days of hands-on training on the hospital floor by another nutrition assistant. The most difficult reading task (DOC 7) was selecting the menus for patients too ill to write their own. It entailed matching the menu features (appetizer, salad, main course, bread, beverage, dessert) with several exemplars, analyzing the exemplar selected against the patient's dietary restrictions and food preferences. Procedural knowledge entailed knowing how to match information from reference materials or from prior knowledge (corresponding prose from the dietary manual or menu guides) to the appropriate exemplars (food choice item) for each menu feature.

Dietary department members attending the focus group meeting all agreed that the task of transferring patient diet orders from the diet change board to the diet change sheet was the most difficult task of the nutrition assistant. The diet change sheet was written up daily by referring to the diet change board near the nursing station. The nutrition assistant wrote up an initial diet order for each patient at 3 p.m. daily. The diet change sheet recorded patient bed and room number, name, diet order, meal, discharges, admissions, comments. The nutrition assistant checked at the nursing station at mid-morning and mid-afternoon for changes in doctor or dietitian orders and wrote them on the diet change sheet in the lunch or dinner column. At each interval, the diet change sheet was signed by the nurse in charge before it was taken from the floor by the nutrition assistant. However, there may have been changes in the interim. In that case, the nursing staff telephoned the nutrition assistant with those changes (holding patient's tray, special orders due to patient condition, new admissions) as they occurred.

This task, rated DOC 7, entailed handling six or more features of information from a variety of sources (diet change board, notes left by medical staff, verbal information from nursing staff imparted over the phone or in person). It was a complex task requiring a high degree of accuracy, and calling on procedural knowledge concerning how to implement such changes in a timely fashion.

The most difficult quantitative task performed by the nutrition assistant was also at the top of our scale (QUAN 6). This task entailed calculating patient intake from a variety of sources: food, liquid, tube feeding formulas, and I.V. feedings. Nutrition assistants referred to tables giving the number of calories per cc. of full strength liquid or formula. Often patients were given one-quarter strength or one-half strength solutions. The task was further complicated by the fact that nurses did not use a standard set of abbreviations on the Intake/Output forms. This task involved matching several features of information and performing more than two operations that required multiplication and division of fractions or decimals. While all work was done by calculator and checked by the dietitian, accuracy was important in performing this task since patients being monitored this closely were usually very ill.

As was mentioned previously, the oral language requirements and interpersonal skills for this job were of a very high degree (OL 3). The nutrition assistant interviewed newly admitted patients and also monitored patient satisfaction with meals. A great deal of trouble was taken at Hospital Site A to satisfy the needs of patients who were not eating well. The nutrition assistant had to be skilled at dealing with patients of various temperaments and had to often "read between the lines" of what was being said by patients. In addition, the nutrition assistant had to judge whether the patient was well enough to make menu selections or whether assistance was needed.

This job required more than 54 literacy tasks: 16 involved the applied use of forms; 24 entailed interacting with written materials to gain specific information; 12 tasks required using prose for gaining specific information, and two used prose for application purposes. The nutrition assistant at Hospital Site A had considerable interaction with patients and hospital staff, thus, using oral language skills in many of her tasks.

Hospital Site C, Nutrition Assistant

The nutrition assistant at Hospital Site C was called a diet clerk. The position was considered to be on the same level as a dietary aide (cook assistant I), and was paid accordingly. At this hospital, because of turnover and absenteeism, all dietary aides were expected to learn and perform all dietary aide positions, including diet clerk. The department head reported that workers had been successful in cross training for all positions except diet clerk because that job entailed a higher level of literacy and interpersonal skills due to the required amount of clerical work and interface with the patients. For this reason, most dietary aides were reluctant to work at the diet clerk position.

As was the case at Hospital Site A, the nutrition assistant's position was highly clerical: keeping patient card file (cardex) current, distributing and picking up menus, writing menus, ordering snacks, and following dietitians' orders. Unlike the nutrition assistant at Hospital Site A, the nutrition assistant at Hospital Site C did not analyze patient diets nor calculate patient intake and output (I & O) data. Special diets at Hospital Site C were implemented by patterns determined by the dietitian. There are appeared to be fewer menu choices and fewer complex dietary prescriptions than at Hospital Site A.

The literacy requirements at Hospital Site C were somewhat lower than those for the nutrition assistant at Hospital Site A but considerably higher than those of other cook assistant

I workers at Hospital Site C. (See Table 13, p. 166.) The most difficult reading task (DOC 5) entailed reading menu selections, referring to patient cards for dietitian's orders and patient preferences, and circling the appropriate selection on the menu. Where the dietitian's pattern called for selecting a food the patient could not or would not eat, the nutrition assistant was required to choose an appropriate alternate, sometimes in consultation with a supervisor or dietitian. Thus, the task entailed matching more than two features and employing procedural knowledge to make appropriate menu selections, but did not entail deciding on the features of the prescribed diet itself as was the case at Hospital Site A. Writing up patient nourishments and referring to cardex files (DOC 6) was a less difficult task than the diet change order task for Hospital Site A's nutrition assistant. At Hospital Site C, the diet change orders were written up by the nurses for the dietitians and were simply collected by the nutrition assistant.

The most difficult quantitative task at Hospital Site C was a simple tally to determine the total number of portions of each menu item ordered (QUAN 1). At the extended care facility, the nutrition assistant did a monthly inventory of stock in the food pantry. We rated this task as QUAN 2, since it involved subtracting the amount of a pantry item in stock from the standard amount to be kept in stock and then making a decision about the amount to order. This task entailed one operation (subtraction), a feature match, and data entry.

Because of the interactions with patients, medical and dietary department staff required of the nutrition assistant, the level of oral language skills involved were similar to those required at Hospital Site A. There was less responsibility involved in the job at Hospital Site C, though, and conducting patient interviews to obtain information for the patients' cardex file was done by the dietitian, not the nutrition assistant.

The intensity and number of literacy events for the nutrition assistant at Hospital Site C was lower than that at Hospital Site A. There were a total of 30 literacy events observed for this job, not including oral language interactions. The majority of these literacy events, 25 in all, involved the use of forms for application purposes. In addition, two tasks entailed using forms in the context of social interaction and three tasks involved applied writing of prose, mostly reading notes or messages and carrying out the tasks indicated therein.

Hospital Site C, Dietary Aide

The dietary aide (cook's assistant) position at Hospital Site C required working interchangeable food line positions, such as measuring and serving portions on individual patient food trays, preparing patient snacks, and assisting in the preparation and serving of food in the patient cafeteria and in the county meals programs. We observed the positions considered to have the most job literacy tasks. These jobs entailed snack preparation, dessert preparation, and special orders preparation.

The most difficult reading and writing task for the dietary aide at Hospital Site C has already been described in Chapter IV. It entailed reading a nourishment list handwritten by the nutrition assistant or dietitian and writing out a tag to be used to label the snack after it was prepared and packaged. Both the reading and writing tasks were rated as DOC 2 (See Table 13, p. 166.), slightly higher than a simple feature match. The reason for this higher rating was that at times choices had to be made by the dietary aide. If an ordered snack were not in stock, a comparable food item had to be selected and written in on the nourishment tag in its place.

The most difficult computation task of the dietary aide entailed reading through the nourishment list to determine how much of each food item was needed from the refrigerator or supply closet and estimating the amount of each food item needed. Knowing this, the dietary aide went to the refrigerator to pick up supplies. While there was an opportunity for the dietary aide to add the total amount needed of a particular item, such as cheese slices for sandwiches, to ascertain how much to bring from the refrigerator, the dietary aide in fact estimated the amount required. This may have entailed an extra trip to the refrigerator, but an accurate tally was not seen to be necessary for this task. This task, then, was rated QUAN 1. (See Table 13, p. 166.)

This job involved only ten interactions with written forms, all for application purposes. Four of these entailed writing or reading signs or labels, or reading directions or simple recipes. Three required working with menus, and three interacting with goods.

Hospital Site B, Dietary Aide

We observed two dietary aide positions at Hospital Site B. As was the case with Hospital Site C, we chose the two positions requiring the most difficult literacy tasks. One of these was the position that involved picking up patient trays, and observing and noting down the amount of liquid consumed by patients requiring I & O monitoring. The other position involved weighing and cutting meat orders for patient meals.

The most difficult reading and writing task performed by a dietary aide at Hospital Site B entailed checking on patient liquid intake for those patients on I & O monitoring, reading the Fluid Measures Chart to locate the correct serving size and the type of liquid consumed. We rated this DOC 4, involving a feature match and selecting from several exemplars. It also required procedural knowledge. A related quantitative task involved multiplication to convert the number of ounces in a serving size to milliliters for entering on the I & O chart. This task was rated QUAN 4, entailing multiplication of one item at a time followed by writing the result on the patients' charts. This task was rendered more complex by the fact that it required a feature match to write the information on the I & O form. The most complex writing task entailed reading a patient order as it came off a telescriber from the nursing unit and transferring the order onto a menu. This called for writing the patient's name, unit and room number on the menu, then circling the correct items ordered on the menu, matching several features of information and having some procedural knowledge. We rated this a DOC 5, at the mid- to high range of our scale. (See Table 13, p. 166.)

The simple weighing, measuring, and labeling tasks done by the other dietary aide observed were all at a DOC 1 level for reading and writing and at most a QUAN 2 level for computation, making the dietary aide job similar in difficulty level to the dietary aide jobs at Hospital Site C. Minimal speaking skills were required for both of these dietary aides positions, resulting in a rating of OL 1 (imparting simple information).

The two dietary aide jobs at Hospital Site B together performed 33 literacy tasks. Twenty entailed using signs or labels for specific information and two involved reference to forms for the same purpose. The ten remaining tasks were related to interactions with goods, and one with a scale.

Comparison of Literacy Requirements Across Sites

The level of difficulty of hospital dietary aides varied according to the way jobs were structured. This was in turn influenced by the skills of available workers and other context variables at the site. The nutrition assistant position at Hospital Site A, while an entry-level job, was essentially that of an assistant to the dietitian. However, it was not classified as a dietary aide job as it was at Hospital Site C. The literacy skills required were thus at a considerably higher level, near the top of our rating scales. The quantitative tasks at Hospital Site A were also at the top of the scale in terms of difficulty level. The nutrition assistant (diet clerk) at Hospital Site C, on the other hand, was required to perform reading tasks at the mid-range on our rating scales. The quantitative tasks at Hospital Site C were at the lowest level on our rating scale compared to those at Hospital Site A which were at the highest level.

Dietary aide job literacy requirements at Hospital Sites B and C were considerably lower than the nutrition assistant jobs just discussed. Most tasks entailed food measurement and production and were at about the same difficulty level at both sites. They were rated at the lowest end of our scales, and estimated to be within the reach of most of the population. One dietary aide position at Hospital Site B involved work with patient intake-output charts, but in a more limited way than was required of the nutrition assistant at Hospital Site A, resulting in a mid-range level of difficulty on our rating scales.

There was a similar number of literacy events across jobs at Hospital Sites B & C. Only at Hospital Site A, where the nutrition assistant's job was very complex, were there larger numbers of literacy tasks.

Literacy Requirements of Next Dietary Department Job Up

Promoted dietary aides at Hospital Sites A and B became lead dietary aides or dietary supervisors. In general, the workers in these positions whom we interviewed reported that their jobs entailed an increased level of supervisory responsibility and leadership skills. They said they were also required to be very flexible, often needing to substitute for absent nutrition assistants or dietary aides. The dietary supervisor at Hospital Site A also was required to write performance evaluations of the supervised workers and to document any disciplinary or corrective action done in relation to them.

At Hospital Site C, promoted dietary aides required higher skills in all areas, including computer data entry, than did the workers under them. The only exceptions were those promoted from diet clerk. The degree of oral language and teamwork skills involved in interacting with patients and working with medical and dietary staff remained about the same in that instance. In the situation where a person was promoted from dietary aide to dietary supervisor, the skill demands in oral language and teamwork skills were reported to have increased. The next section of this report discusses the nature of the literacy requirements for entry-level laboratory assistant positions at the three hospitals visited.

Literacy Requirements of Entry Level Hospital Laboratory Workers

In many ways, hospital laboratory assistant jobs were the most complex and varied entry-level jobs observed. Laboratory assistant jobs called for a high degree of technical/procedural knowledge; their reading and writing tasks were the most difficult to rate of those documented in this study. Highly clerical in nature, the lab assistant job entailed a large volume of computer data entry and required accuracy and attention to detail.

Nature of Job Literacy Skills Required

At two of the three hospitals studied where laboratory assistant jobs called for considerable use of computer data entry skills, the level of difficulty of the related literacy tasks was influenced by the way the software was designed and utilized. The use of sophisticated medical technologies was also a factor in these jobs. As a result, entry-level workers' jobs were constantly changing, and workers were required to continually learn new literacy-related and procedural skills. For this reason, the training level literacy requirements for the jobs we observed in hospital labs were applicable throughout to our assessment of their difficulty level. That is, job literacy tasks required attentiveness and could not be performed by rote.

Document reading and writing skills in two of the four lab assistant jobs observed (Hospital Sites A and C) were rated at or near the top of our scales. (See Table 13, p. 166.) The two lab assistant posititions at Hospital Site B, both of which were highly weighted toward clerical and data processing skills, varied in complexity. For each job, though, the most difficult document reading and writing tasks were at or near the top of our rating skills. Lab assistants were required in most instances to perform few quantitative tasks. The most-difficult quantitative task observed at one site was mid-point on our scale. (See Table 13, p. 166.) Those tasks at the remaining two sites were at the bottom.

This section describes the literacy skill requirements of each lab assistant job separately by site, followed by a discussion of the requirements across sites. In order to be promoted to medical technologist or laboratory technician, a worker needed college or technical school degree work. We were unable to interview a recently promoted worker for this job category.

The Most Difficult Job Literacy Tasks at Each Site

Hospital Site A, Chemistry Laboratory Assistant

The chemistry lab assistants did all the preparatory work prior to the actual performance of lab tests by the medical technologists. They also conveyed test results by computer printout to an extensive number of wards, clinics, and private physicians. They handled a heavy paperwork load and were familiar with the preparatory procedures for 150 tests.

The most difficult writing tasks for this job centered around entering data for tests ordered from laboratory requisitions slips. (See Table 13, p. 166.) These tasks (rated at the top of our scale, DOC 7) entailed six or more feature matches with several exemplars, and required considerable familiarity with laboratory procedures, technical vocabulary and abbreviations.

The second most difficult document reading task entailed reading the requisitions and making sure they were labeled and set up correctly. It was here that we were able to factor in the procedural knowledge just discussed. This task required considerable procedural knowledge and involved examining six or more features with several exemplars for each (DOC 7).

Although lab assistants themselves perceived answering the telephone and providing test results to medical personnel as their most difficult task, we estimated that the complexity of the reading tasks for this activity was not as high as the task involving the checking of requisitions just described. This task required a high level of procedural knowledge and interpersonal skills. Rating the oral language skill level required of lab assistants at OL 2 (conveying narrative information) on a scale of three may not have depicted adequately the complexity of the task. Physicians wanted results conveyed quickly -- and accuracy was essential.

The quantitative tasks for Hospital Site A's lab assistants were minimal. They entailed estimating the number of specimen labels required to complete the requested number of tests and counting the number of specimen tubes received with each requisition to make certain that the necessary number were there. Although we rated these tasks at the bottom of our quantitative scale (QUAN 1), we realized that procedural knowledge was involved in knowing the number of specimen tubes required for each test requisitioned.

Laboratory assistants at Hospital Site A rotated among several work stations and were thus required to know all of them. All literacy tasks had to be completed with a high degree of accuracy. The job was highly intense, involving 56 literacy events according to our observer. Nearly two-thirds of these, 41 in all, involved interactions with forms. Uses of forms were mainly for application (data entry), specific information (reports, print outs, or double checking data entries), or evaluation (checks to see if procedures and materials were congruent with tests requested). Eight of the literacy tasks entailed the use of goods (test tubes and computers) and seven involved writing or checking labels.

Laboratory Assistant, Hospital Site B

Laboratory assistants in Hospital Site B were observed in two pathology laboratories: microbiology and chemistry. Administrative tasks at this hospital were highly computerized and laboratory assistants were required to input data and to read computer screens most of the time. One hundred percent of the microbiology laboratory assistant job was clerical, as was 75 percent of the chemistry laboratory assistant job. (The remaining 25 percent entailed specimen handling.) Literacy tasks entailed constant reading of menu-driven software computer screens and printouts for the purpose of entering data or providing information over the telephone. Lab assistants had to read abbreviations of test names and interpret hastily scribbled test requisitions. As was the case in Hospital Site A, the lab assistants as Hospital Site B believed that handling physician telephone requests for test results was their most challenging job task.

Our analysis showed that the literacy requirements of the laboratory assistant jobs reported were very similar. The most difficult reading and writing tasks entailed document reading requiring a four feature match with several exemplars, and procedural knowledge of how to operate the menu-driven software to enter the lab results. We rated this task at DOC 6, next to the top on our scale of document reading difficulty. Another writing task in the chemistry lab called for the laboratory assistant to assist in logging in, spinning, and decanting specimens. The logging in tasks required two or more feature matches with prior procedural knowledge (DOC 5). They also involved a literacy opportunity task, which could be a requirement if the laboratory technicians were too busy to answer questions. This was a prose reading task (PR 3b). It entailed referring to reference materials when the lab assistant was uncertain of specimen handling requirements and needed to look them up. Computation skills were minimal at Hospital Site B's labs, usually involving simple counting of supplies in maintaining an appropriate inventory of ACA equipment. (See Table 13, P. 166.)

Interestingly, the clerical and administrative aspects of the chemistry lab assistant job involved taking responsibility for prioritizing the work tasks of the lab in order to maximize the workflow. It thus entailed maintaining positive working relations with other lab and hospital personnel. This required a high level of interpersonal skills, sometimes requiring persuasive speech (OL3).

The microbiology lab assistant's most difficult reading and writing task entailed computer data entry from the laboratory technician's worksheets. The observer reported that this particular task required considerable procedural knowledge because the software in use was very complex, having a number of alternative paths to data entry. Thus, a good understanding of the meaning of test results was essential to accurately completing the task. The terminology used by lab technicians in writing notations on the report did not always match well with the fields available on the computer screen. For this reason, we have rated a task that might be seen as a feature match requiring procedural knowledge as one entailing a four or five feature match with several exemplars (DOC6). In addition, since the microbiology laboratory assistant also served as the department secretary, prose reading of relevant memos, notices, procedural directions was also required. These materials were then interpreted and passed on to others in the department. Thus we have rated this task as 3b on the prose scale, "interpret a written directive." (See Table 2, p. 114.)

The most difficult quantitative tasks entailed adding the number of tests reported by the lab techs on their worksheets and writing the result on a master worksheet. We rated this as QUAN 2, a relatively easy task: one operating task, plus a feature match and data entry. As was the case with the chemistry lab assistant, the administrative duties of this worker required good interpersonal skills and oral language levels requiring persuasive speech (OL3).

The laboratory assistants at Hospital Site B together performed an average total of 93 literacy tasks, with about equal numbers of literacy tasks in each job. The chemistry lab assistant worked more with specimens and materials such as labels, goods, and forms. The microbiology assistant had more interactions with computer screens for data entry. One-third of these interactions entailed reading a variety of documents for specific information: labels, directions, memos, forms, references, notices, and interaction with goods. The remaining tasks entailed using these same types of materials for application purposes, usually computer data entry.

Laboratory Assistant, Hospital Site C

The laboratory assistant position at Hospital Site C was considered by the field observer to be the most technically complex of the lab assistant positions observed. The county required that lab assistants have prior experience in medical laboratories or have a taken 15 credits of science beyond high school. Even with such experience, the technology used at the hospital required considerable on-the-job training for new workers. This was accomplished through shadowing an experienced worker. Written guidelines accompanied the training provided in this way. These guidelines outlined the essential instructions, procedures, and behavioral guidelines required of laboratory assistants. The guidelines included location and care of equipment, procedures and expectations for the job, specific procedural requirements for blood drawing and culturing, and patient first aid and emergency procedures.

The laboratory assistants at Hospital Site C collected blood and urine specimens and performed routine blood counts, glucose tests, and urinalysis tests. The most difficult reading task for this position entailed conducting complete blood counts using a high tech menu-driven instrument. This task required the procedural knowledge of understanding how the instrument functioned, which automated features to utilize, what blood components were to be analyzed, and what the acceptable parameters were for each of the components tested. The lab assistant needed to focus on three features on the instrument screen at any given time, referring to the operations and testing guidebook attached to the instrument or to a one-page summary in the lab's hematology procedures manual to determine the normal parameters for such test results. The lab assistant then analyzed whether the results described on the computer screen fell within acceptable parameters. Further, the lab assistant needed to analyze whether the instrument was functioning properly and whether the results of the test were abnormal or peculiar enough to require the immediate attention of the supervising medical technologist. Because of the procedural complexity of the task and the number of exemplars the lab assistant must sort through to determine normal parameters, we rated this reading task near the top of our scale at DOC 6.

The most difficult writing task for the lab assistant at Hospital Site C involved the administrative processing of lab slips. The lab assistant initialed the patient test log at the nurses' station for each patient whose blood was drawn. Any unusual occurrences were also described on this log; this task entailed production of some prose. We rated the prose aspect of this task as PR 2b: writing several sentences using prior knowledge. The document writing task involved in completing lab slips is a DOC 4, a one feature match requiring prior procedural knowledge. The oral language skills required of the lab assistant when interacting with patients, especially during blood drawing, were very difficult, requiring sensitivity to patient condition and persuasive speech (OL3).

The most difficult quantitative tasks entailed mixing specimens with solutions based on ratios of solution to blood. If the lab assistant was not familiar with the test to be performed, he/she calculated the amount of solution by dividing. Such a task was rated as QUAN 4, at the high midpoints on our scale. The task observed was that of performing an erythrocyte sedimentation rate test. This required mixing the blood specimen with citrate solution using a 4:1 ration of blood to citrate. This ratio was determined by dividing the amount of blood by four and then adding an appropriate amount of citrate solution to the specimen. For experienced workers performing tests not often repeated, or for a trainee, such a task involved performing one operation using division. Probably for the more familiar tests, experienced workers did not have to perform a calculation, having memorized the amount of solution required.

The laboratory assistant position at Hospital Site C was a highly technical one requiring extensive knowledge of laboratory procedures and the performance of a number of routine blood and urine tests. The only data entry task entailed using a high tech instrument for performing complete blood counts. This position also required extensive interaction with patients. The lab assistant at Hospital Site C encountered somewhat fewer literacy tasks, 41, than did those lab assistants at other sites. Furthermore, there was more variety in the types of forms used at Hospital Site C, including labels, directions, memos, forms, schematics, goods and scales. Most of these entailed the use of materials for application purposes. Some involved using a measuring devise, and four employed a reference for gaining specific information.

Comparison of Literacy Requirements Across Sites

There was considerable variation in the way laboratory assistant jobs were implemented in the three hospitals visited. Nonetheless, the reading tasks at all three sites were at the most difficult levels on the document tasks. In addition, lab assistants at Hospital Site B were required to do some reading and writing of prose. Writing tasks varied across the three sites. The level of difficulty was affected by the complexity of the software involved and by the number of tests (with their attendant varied abbreviations) being reported. Thus, Hospital Site A's lab assistant's writing tasks were more varied in their difficulty level, DOC 7, as compared to Hospital Site B's DOC 5 and Hospital Site C's DOC 4. Hospital Site C did not use menu-driven software to report laboratory test results; thus, the process of writing out laboratory test results was far less complex than at the other two sites.

Oral language skill requirements at all three sites were at the top of the three point scale. Lab assistants at all three hospitals had responsibilities requiring a high level of interpersonal skills, both during interaction with one another and with medical staff. In addition, lab assistants at Hospital Site C performed a number of tests on patients and were required to be sensitive and persuasive in those interactions.

Computation tasks for laboratory assistants were less complex than those required of entry-level nutrition assistants. Both Hospital Site A and Hospital Site B lab assistants were at the low end of the quantitative scale. Hospital Site C's lab assistant was required to perform more complex calculations in the course of diluting specimens. These tasks were rated near the top of the scale for difficulty level.

The next chapter presents a summary of outcomes and conclusions from this study.

VI. SUMMARY AND CONCLUSIONS

Summary of Outcomes

In this section, we will briefly summarize the outcomes and findings of this Study of the Level of Literacy Required in Specific Occupations.

Operational Definition of Workplace Literacy

For the purposes of this study, an operational definition of workplace literacy was developed. This definition proved useful during the study and was modified only slightly as a result of our findings. The definition captures the interactions between the worker, the text, and the context that characterize workplace literacy as it differs from literacy in other settings. We define workplace literacy as the **integrated use of reading, writing, mathematics, listening, speaking, and related cognitive skills to perform job-related tasks. This often requires the application of prior experience.**

Usefulness and Effectiveness of Protocol

One of the goals of the study was to develop and field test a protocol for gathering data on job tasks involving literacy. The results of the field test show the protocol is a useful tool for documenting such tasks as actually carried out on the job. It enables the user to distinguish between employer perceptions of job literacy requirements and the actual observed requirements. It also makes it possible to discriminate between literacy opportunities and literacy requirements for workers. This is important because literacy opportunities, if mistaken for requirements, can artificially inflate the assessed difficulty level of the job. It is also important because, although not essential to the day-to-day requirements of the job, opportunity tasks represent ways for workers to distinguish themselves on the job and to demonstrate their potential for advancement.

The protocol is useful for studying jobs of varying complexity in different settings; it is likely, therefore, to be applicable to studying jobs beyond the entry level. The protocol is flexible enough to be usable for a variety of purposes. Collected data can be used by business and industry for setting hiring criteria, assessing applicant competence, planning for training programs and for implementing innovations. For example, by comparing the difficulty level of the literacy tasks associated with data entry using different menu-driven software programs, planners can assess the impact different software would have on the literacy requirements of the job. They can then plan ways to deal effectively with that impact.

The protocol will be useful to the Department of Labor for gathering specific data on job literacy requirements in order to create youth competency measures and to develop tools for assessing the readiness of young people to enter the workplace. Department of Labor funded programs will be able to use the protocol to identify the actual competencies required of workers in reading and writing documents, and in performing calculations required on the job. These competencies can be used as the basis for relevant curriculum and lesson development.

Effectiveness of Rating Procedures

A second goal of the study was to develop a means of assessing the difficulty level of job literacy tasks. We have created a set of scales for this purpose. This set of scales uses the conceptual framework developed for the NAEP Young Adult Literacy Simulation Tasks as a point of departure. The procedure for rating the difficulty level of job literacy tasks requires breaking literacy tasks down into the components a worker has to address in a single transaction, accurately describing the components and obtaining related documents, then following a clearly defined three-step rating process. With careful training, it is possible to arrive at reliable ratings of the difficulty level of job tasks. It is important to note that the reliability of the ratings is highly dependent on the quality of data collected at the work site. It is essential that such data document the way a literacy task is actually carried out by workers and that it be supported by documents filled out by workers as they perform the task. The protocol facilitates the collection of such data.

The rating procedures enable observers to distinguish the literacy level of jobs of varying complexity and of literacy tasks with varying levels of difficulty. By making comparisons within and across [illegible] categories, it is possible to determine the relative difficulty of the literacy tasks required for the jobs being studied.

Relating Job Literacy Tasks to NAEP Simulation Tasks

A goal of the project had been to relate job literacy tasks to the NAEP Young Adult Literacy Simulation Task items. It was not possible to gain access to the NAEP items before the end of the project. However, as a result of our preparations for carrying out the analysis, we were able to make some observations about the value of using the NAEP items for this purpose. By using the NAEP matrix of materials and uses, we determined that the NAEP tasks corresponded well with many of the materials and uses we documented in the workplace. We also identified categories where job literacy materials and uses found in this study were not addressed on the NAEP. These included interactions with goods and materials, measuring devises, and computer software.

The criteria for selecting items to serve as anchor points to the NAEP scales of literacy were that those people who functioned at that level of literacy were able to respond accurately to an item 80 percent of the time, while less than 50 percent of those people functioning at the level below could respond to it correctly. In many workplace settings where safety issues, data affecting decisions about patient treatment, or even cost control or product quality is at stake, a much higher level of accuracy would be demanded.

It would be difficult to equate the skills required to perform successfully on the job with those skills required for performance on the NAEP because of the different context each of the sets of skills requires. Job literacy tasks are often driven by previously learned job procedures or by oral instructions rather than by written directions as was the case with the NAEP items. Rote memorization plays a significant role for workers carrying out many tasks that would require more sophisticated skills of someone attempting them for the first time. Literacy tasks in the jobs we studied tend to be highly repetitive in nature. Many workers we observed did not appear to be facile manipulators of literacy skills, yet they could accurately perform relatively complex literacy tasks once they had become familiar with them. Yet in responding to the NAEP literacy simulation tasks, the young adults being assessed are expected to perform a task for the first time or at least to deal with unfamiliar components of the task. The impact of the difference between these two contexts on the use of the NAEP literacy simulation tasks for predicting job performance needs to be more fully examined while recognizing that the capacity to learn new skills and to apply one's literacy skills to new tasks is vital in today's changing workplace.

Changing Nature of Job Literacy Requirements

Many factors affect the difficulty level of entry-level job literacy requirements. Although our sample was small, the variation found in the literacy levels of similar jobs at different sites raises questions about how effectively job literacy requirements can or should be considered independently of the environment in which work is being performed.

Employers have a fair amount of control over the difficulty level of entry-level jobs. Literacy and other job tasks tend to be defined by a number of factors, including the skills of the available worker pool, the demands of the industry itself, cost control measures, management philosophy, competition, work volume and pace. We conclude that the disparate nature of literacy skill requirements for entry-level jobs calls into question the value of standard industrial job classifications for describing jobs when the classifications are to be used for job placement or micro-level planning.

Setting Hiring Criteria

In this small sample, it appeared that employers varied in the degree to which their hiring criteria matched the level of difficulty of the job literacy tasks. At two of the three manufacturing sites, employers stated that workers needed at least a high school diploma to perform their jobs. They also believed their current employees lacked the basic skills to perform the work expected of them. The exception to this was, interestingly, the site that had fully implemented team production. Company officials there did not require a high school diploma, and reported that workers had the necessary skills to master the job literacy requirements and training. They found that applicants self-selected; during the hiring process they were made aware of the skills required to qualify as core operator. Those who took jobs on the production team were found to be capable of performing them. Workers were found to sometimes leave the job because they lacked the ability to function successfully as team members. Otherwise, there were few failures to qualify at the end of the nine months on the job.

In the two private hospitals visited, hiring criteria were set by department supervisors who were usually well aware of the requirements of jobs. At the county hospital, requirements were set at the county office, and initial screening was done through a relatively elaborate process there. All three hospitals had lengthy selection processes, and in the case of the largest facility, used customized screening instruments based on actual job literacy tasks. There were no minimum educational requirements for entry level hospital workers, and in both dietary department positions and laboratory assistant jobs studied, there were a number of workers who did not have high school diplomas. In one hospital, where the lab assistant job was more technical and less clerical, either prior laboratory experience or post-secondary science credits were required.

Further, the study results lend support to the notion that employers do not always have the information they need to set hiring criteria, and that such criteria are sometimes based on information that does not accurately reflect the literacy skills workers need and use on the job. Such artificially inflated job entry requirements could result in screening out workers who could successfully perform the literacy requirements of the job.

Literacy Requirements of Entry-Level Jobs

Entry-level manufacturing job literacy requirements vary according to the extent to which traditional assembly line work is being modified to a production team approach. Quality control, the use of team approaches, the introduction of job rotation and statistical process control procedures also increase job literacy requirements. Traditional assembly line work entails few job literacy tasks and minimal calculations. Team approaches to manufacturing in which all workers are required to be certified to perform all tasks on the line result in literacy requirements at the high end of the literacy task rating scales.

In hospitals, jobs tend to be defined by the availability of skilled entry-level workers and by the need to cut the cost of professional salaries or to address a shortage of professional workers. Thus, nutrition assistant jobs vary from high to low-mid range on our literacy scales, depending on the extent to which tasks often done by registered dietitians are assigned to their assistants. Dietary aides may be required to learn the full range of job tasks performed by dietary department workers, or they may be assigned a limited number of repetitious job tasks found to match their skills. Similarly, laboratory assistants are sometimes trained to perform tasks traditionally done by laboratory technicians. In other settings where there is no shortage of technicians, laboratory assistants' work is primarily clerical.

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APPENDIX A

SITE PORTRAYALS

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INTRODUCTION TO SITE PORTRAYALS

These site portrayals were not originally proposed as a part of the Study of the Level of Literacy Required in Specific Occupations. As we began data analysis, we saw that the data collection had yielded rich information on the unique context at each site. This information provided an important backdrop to our understanding of the jobs under study, explaining why they were structured as they were, and illuminating factors affecting the difficulty level of jobs that extended our understanding of their literacy requirements.

MANUFACTURING SITE A

During our initial visit to this rural New England plant, we learned that the enterprise had originally started as a family business and had grown over the years into a major supplier of instrument panels (IP's) for the American automobile industry. Even though it had been purchased by a large corporation, the company had managed to retain a small, family-business character. The 300,000 square foot facility (including a 40,000 square foot warehouse) we visited had been built in 1965. It employed a total of 825 people, of which some 525 are hourly workers. It operated first, second- and third-shift lines on a five-day schedule; overtime and weekend operations were added when necessary. The manufacturing/assembly floor was managed by three supervisors. Line foremen typically supervised between 12 and 40 workers. Although this was a non-union shop, a strong seniority system prevailed. While two-thirds of the hourly workforce was still paid according to a work incentive system, that was being phased out as being inconsistent with the quality principles being implemented.

The entry level jobs selected for study were assemblers and packers of instrument panels. We observed two experienced assemblers and one novice assembler. Assemblers inserted speaker grills, plastic trim parts, and auto-make design emblems into the instrument panel, using three separate worktables to complete the task. From there, the IP's were passed on to the next station, where they were inspected and padding operations took place. We also observed three packers, two experienced workers holding that position for one to three years, and a man who had been with the company for 15 years but had worked as a packer for only two months. The main function of packers in this department was to pack the instrument panels for shipping. They prepared baskets for packing, prepared and checked shipping labels. They also were responsible for inspecting the packing area at the beginning of each shift and filling out a check list form to document the results of the inspection. We saw little difference in the way the three workers performed the job.

Organization of the Work

The plant had just recently moved towards backwards integration, setting up an injection molding department following a company-within-a-company model. Some 70-80% of the plant's production was for General Motors upscale cars.

Plant operations appeared to be typical of transitional manufacturing environments, i.e., there was a gradual shifting from traditional, essentially linear, machine-driven assembly-line operations to work areas wherein equipment was designed for teamwork. Two new production departments (the GM10 and APV lines) were good examples of this; work was organized in semi-circular workcells with materials moving mostly by push-pull technologies. Although we did not see these two departments in operation, we were told by supervisory personnel that work on the lines was organized in teams, reflecting the way GM was producing the GM10 and APV models in its own assembly plants. Plant officials indicated that this was the direction all plant operations were heading for the future.

Work on the production floor was largely manual. Most workers spent the entire shift on their feet, and there was a good amount of stretching, twisting, lifting, and manual dexterity required.

In the department we observed, a traditional assembly line organization was still in place. Two workers were assigned to the assembler tasks. Those observed on the first shift agreed between themselves to divide their responsibilities so as to accomplish the job more efficiently. One assembler snapped hard plastic parts into place and inserted the auto-maker's script for riveting. The second secured parts with a power screw-driver and riveter. This use of teamwork was their own idea. Workers on each shift were free to decide whether to team up and how to divide or share tasks. In fact, we observed that second and third shift workers did not team up, treating the work at each station as separate tasks.

Nature of the Workforce

This plant had a relatively mature workforce, with the average age of workers estimated at 40. Approximately 150 employees had worked there 20 years or more. Although we were told that problems with absenteeism and substance abuse reflected those found throughout mature industry, they were greatest on the 2nd and 3rd shifts, and were more a function of age (youth) than educational background. We nevertheless heard neither managers nor workers complaining about such problems during our four-day site visit. Managers estimated that some 40% of the hourly workers had not completed high school. No minimal educational level was required for employment, and no pre-employment skills testing was done. While managers preferred to hire high school graduates, given the extremely tight labor market in their area, they had to take what they could get. Managers also indicated that workers probably required the equivalent of an 8th grade reading ability and good physical condition in order to do the jobs required of them. All workers learned their jobs by watching and working alongside experienced workers. No formalized on-the-job-training program was in place.

Competence of the Available Worker Pool

Management was of the opinion that most workers did not have the basic skills necessary to do the job, especially in the areas of statistical process control and quality team training. They were concerned that as these innovations and others planned by the company were implemented, worker skills would be increasingly shown to be deficient. As we discussed earlier, the company was moving toward a team module production concept and job rotation. Thus a group of people would work together as a team to perform a series of tasks, rather than having one person do the same repetitive task all day. The literacy skills required for team training required some prose reading and writing.

Workers were also required to participate in quality teams called ACE teams. Some had balked at this, and management suspected they were intimidated by the mandatory task of writing meeting minutes and preparing reports on troubleshooting activities. Many were thought to fear losing their jobs if management discovered their lack of basic skills. The company had begun offering GED preparation courses on-site, and workers were enrolling in these in large numbers, whereas they were reluctant face the possible stigma of enrolling in literacy or basic education courses. During our worker interviews, we learned of one assembler who at first angrily refused to participate in the ACE team (quality control) meetings. Subsequently, she began attending adult basic education classes in a near-by city and participating actively in the ACE team at work.

Management reported that long time workers were very competent to perform the day-to-day operations of the job and were more oriented to the American work ethic than were younger employees. Older workers were also thought to be more dependable and to have more common sense.

Perspectives on the Literacy Requirements of Jobs

As we just discussed, management believed that entry level workers needed to have at least a high school diploma to perform the increasingly difficult literacy requirements of the jobs. They were finding that younger workers were better able to perform job-related reading and writing tasks than were older workers but lacked the problem-solving and common sense of the older workers. Indeed, our observations documented a wide discrepancy between the literacy requirements for the day-to-day performance of the job and those required for training and working on production and problem-solving teams.

Team meetings and training demanded higher speaking, analytical, and oral language skills as well as taking a turn at team meeting minutes and writing reports. This discrepancy between the literacy level required most of the work week, and that required only one or two hours a week, was creating serious morale problems and resistance to the changes the company was implementing. From the perspective of some workers, such meetings were not relevant to their jobs and were highly threatening.

Other Literacy Requirements

Management was required to inform workers of safety information and precautions. They also had to communicate the facts found on the hazardous materials data sheets. The safety engineer found it a challenge to make the data sheets currently available understandable to the worker. He found films a useful means of communicating much of the essential information. Since our readability analysis placed these sheets above 14th grade reading level, it was clear that using films was a valuable way of communicating this essential information. It was unlikely that its written form would be accessible to most of the workforce.

The company was also concerned about providing the workers with readable, understandable material concerning insurance benefits, pension plans and the like. Personnel considered this to be a problem area and believed that much of the written material was too difficult for workers to understand. When we talked with workers about this, they reported that they did not read the material, preferring to go to Personnel with questions as the need arose. This material, too, was written on a level too difficult for most workers according to our readability analysis.

Communication among the workers was also important, according to both the workers and the managers we interviewed and what we personally observed while at the plant. Noted one employee, a troubleshooter for three assembly lines, "Getting along with other people in your area is very critical; it makes work more enjoyable, even tolerable." The workers often chatted and joked, back and forth, even across workstations when that was possible; most also participated in conversations that took place in the restrooms (where smoking is allowed) during breaks and in the cafeterias during lunchtime. Many employees also participated in various plant-sponsored after-work activities (e.g., golf, bowling, Winter Carnival Committee). Workers often posted notices of items for sale, golf scores, bowling team results, etc., on the bulletin board outside the main cafeteria. Thus, while a lack of English-language speaking and listening skills and/or a deficiency in reading or writing may not necessarily inhibit job proficiency, full participation in the culture of the workplace was aided by literacy skills.

Training Concerns

Manufacturing Site A had a strong commitment to training. The difficulties they were facing in providing workers with the skills needed for planned innovations were discussed earlier. Progress was being made in involving workers in basic skills training. We believe that if training materials were found that relate more closely to worker vocabulary level and reading ability, the task of gaining worker cooperation with training activities would become easier. In the meantime, the trainer often read team training materials aloud to trainees and as far as possible used means of involving them in exercises that did not require reading and writing.

Statistical process control was said to be difficult for the entire workforce. The training department was looking at a training package using computer software. They were concerned about how to teach SPC to illiterate workers. The automotive companies Manufacturing A supplied had begun requiring that workers keep SPC charts, fill out graphs and compute averages. Although no abstract mathematics was involved, many workers lacked the basic skills to learn what was required.

Reading Actually Done By Those Observed

The actual basic job literacy tasks for the two jobs observed at Manufacturing Site A were few in number and placed at the lowest level of our literacy scales. Because of the repetitive nature and rapid pace of the assembler's job, we found that experienced workers were unaware that any literacy skills were involved in their job. It was from the novice worker, who had been at his job for about 4 months, that we learned that assemblers read stock labels attached to the boxes of parts to ascertain where to place them on the shelves above the assembler's bench and also how to determine whether the label on the box and the re-order label inside the box matched. This required only matching one or two features on identical tags (DOC 1). The job required no measuring and had few literacy opportunity tasks. The one opportunity task observed was seen only on the first shift, where quality control had asked assemblers to save every script that broke while being screwed into place. At the end of the shift they were asked to count up the number of broken scripts and write the date and total on a scrap of paper (DOC 1, QUAN 1).

Manufacturing A's packers were required to perform only limited reading and writing tasks. The packer applied a knowledge of the job tasks to an inspection of the area at the start of the shift. He then made certain that the task listed had been completed during a previous shift, entering a check mark in the appropriate space on the form. This task required feature matches and a minimal knowledge of the job routine, and thus was rated DOC 2.
In addition to the minimal literacy requirements described above, as we discussed earlier, Manufacturing A assemblers and packers were given training in group process skills, most of which consisted of consensus seeking activities. Reading materials used for the exercises placed them at a reading grade level of just about 12th grade. (Newspapers and popular magazines are written on an 8th grade level.) This task turned out to be a literacy opportunity rather than a requirement, since essential information was read aloud during training sessions.

Participation in the ACE team meetings was required, however, and demanded considerable analytical and oral language skills as well as taking a turn at writing meeting minutes and presenting reports. The most difficult writing tasks for the job then involved the production of prose involving either writing several sentences requiring prior knowledge or generating a theme from short text and familiar metaphors, a level 2b or 2c on our prose scales. Oral language skills required persuading others of a point of view (OL3) as compared to simple language requirements for assembling and packing products, involving simply imparting factual information (OL1). This discrepancy between the low level literacy requirements of the job and the relatively high levels required once a week in team meetings was the cause of considerable anxiety and sometimes aroused hostility in even long term and successful workers.

Summary

Manufacturing A, as a transitional industrial environment, was a very interesting site for studying the literacy requirements of entry level manufacturing jobs. It provided valuable information about the challenges facing U.S. manufacturers as they worked to retain a competitive place in the international market by implementing practices believed to be essential to so doing. It demonstrated the impact such innovations have on the literacy requirements of entry level jobs and the obstacles to be overcome in ensuring that workers have the basic skills necessary to perform their newly defined jobs successfully.

MANUFACTURING SITE B

Manufacturing Site B was a family-owned company employing 320 employees in an industrial city in northeastern Massachusetts and another 300 in seacoast New Hampshire. The company started out some 25 years ago at a plant in the Massachusetts city making mid-soles and inner-soles for shoes and polyester/latex resins. Much of that work was now done at a subsidiary plant in Australia. The automotive division in Massachusetts made sub-straits for vinyl roofs and seats, undercollar stiffening materials for suits, and non-woven carpet and trunk lining for automobiles, trucks, and marine usage. It also made respirator products and commercial wall covering.

The factory used heavy machinery manufactured primarily in Germany. Temperature and pressure gauges were controlled by the machine operator, and some aspects of the line were monitored by electric eyes. The non-woven fabric division took crimped and dyed fiber, made in the New Hampshire site from re-cycled plastic soft drink bottles, and converted it into fabric. The machinery consisted of a feeder into which raw fiber was fed and moved along belts monitored by electric eyes into a loom-like machine. There moving fiber was heated and pressurized as it passed over rapidly moving metal needle boards that formed it into fabric. The fabric moved along a belt onto a spool. When the fabric reached end of the belt, it was trimmed by cutting wheels to the specified width and rolled onto a cardboard core. When the correct length of fabric had been wound on the core, it was trimmed off, and "doffed" or removed to be weighed, packaged and shipped. The end of the fabric was then wound around a new spool and a new roll started. In this department, we observed two experienced tender/helpers and one novice who had been on the job only three weeks. These entry level workers assisted the machine operators. The operator promoted from the tender/helper job was our interview subject.

At another wing of the factory visited in this study, pieces of non-woven fabric were cut (using various dies and straight-cut machinery) according to customers' specifications; manually trimmed, inspected, and packed by an inspection team; and then shipped off to various automotive assembly plants. It was the trimming, inspecting, and packing operations, performed by inspectors (an entry-level position at the plant), that we observed. We shadowed two experienced packer/inspectors, one of whom was also the team leader. The recently hired packer/inspector observed had been in her job just over 60 days.

Organization of Work

Work in the non-woven fabric production was generally organized on a linear assembly line. The non-woven fabric division had a shift supervisor and an operator who oversaw all lines. Each line had a team made up of an operator and a tender/helper, who acted as an assistant. The tender/helper's job was to keep the machine filled with fiber, to package rolls of fabric, and to generally assist the operator. The operator was responsible for operating the machinery and ensuring that the fabric met the specifications of the work order. This entailed adjusting temperature and pressure gauges, troubleshooting (often with the tender/helper and supervisor) when the fabric being produced was defective in some way, and making appropriate adjustments to the machinery. The operator also kept production and quality control records, performing calculations and filling in forms.

While the tender/helper was not required to do any of the paper work, opportunities existed to do so. Training directors reported that, from management's perspective, the more the tender know of the operator's job the better. This made it possible to promote him to the operator position. The operators interviewed reported that the better the tender knew the operator's job the more effective the team can be. Both agreed that teamwork between them was essential to the successful operation of the line.

Trimming, inspecting, and packing operations were performed by an inspection team comprised of four to six individuals, one of whom was designated by the supervisor to act as team leader. (Here it should be pointed out that neither the group itself nor management referred to the group as a "team.") One supervisor oversaw all operations that took place within the entire plant wing.

The inspection team leader (chosen, at least in great part, because of seniority in the inspection job) had primary responsibility for the paperwork that accompanied each work order and for making certain all work got done well and on time, that the correct labels with all the ID information required by the customer were attached to the cartons, that the parts being processed were indeed as per the customer's specs, that the pace of work matched the timelines for shipping out customers' orders, that all pieces were trimmed, inspected, and packed in accordance with both customer's specs and what Manufacturer B knew to be high-quality inspection/packaging. The scissor trimming and careful inspection of every cut piece took place around a U-shaped table (approx. 6 feet per side). Behind and to the side of the table, the inspector/packers set up the customer order by assembling and labeling the cartons in which the parts were to be sent; they then packed and sealed them as they finished trimming and inspecting the pieces. They then loaded the sealed cartons onto skids (per customer's maximum skid height specs), moved the skids by handcart to the weighing area, and deposited the weighed skids at the shipping department located at one end of the plant's wing. All inspectors, including the team leader, participated in all the various aspects of these tasks. While it was the team leader who started the group out on each new customer order, verified and typically completed the required labeling and other paperwork, and was generally looked to as the "expert" among the others, the designated team leader served in a leadership rather than supervisory capacity. Any division of labor within the group occurred on an ad hoc basis, usually happening without verbal exchanges about who would do what. One person would simply start packing a carton, for example, while the others were still inspecting additional pieces that went with the shipment; someone would decide there was too much fuzz on the table and proceed to clean it off; another worker would begin counting how many pieces were still needed to fill a carton.

Nature of the Work Force

The nature of the work force at Manufacturing Site B was changing. Approximately 20% of all workers there were members of the Teamsters Union. The plant manager described the current work force as a "swing population", explaining that formerly there were many workers 50 to 60 years of age, but that now the average age of workers was 25. He said that 15 years ago the equipment there was less sophisticated which meant that paper work was very limited, involving only reading scales or tape measures. Supervisors were able to complete any reading and writing tasks required. Today the workers were required to do paperwork. This change had recently resulted in a long time worker being demoted because he was illiterate and couldn't do the paper work required. The manager was concerned that the basic skills of the current work force were not strong enough to make them promotable. He noted a deficit especially in the analytical skills of the current workers.

As a rule, Manufacturing Site B preferred to bring workers up from the ranks, filling most job vacancies from within. At the time of the site visit they had more jobs than people to promote into them. As a result, some employees had been promoted because they were the best available people there. The plant manager questioned whether, even after training, such workers had what he termed the "horsepower" to do the job. He said, "Errors such as misplacing or forgetting a number can cause a lot of problems. If workers don't understand the SPC plotting, they can't make the proper adjustments in the machine settings. Analytical ability is important.".

All inspector/packers at Manufacturing Site B were women; all appeared younger than 25 years of age. The team leader had been an inspector for six months; the newest hire had worked there one month. (As previously noted, job turnover at this plant was high.) These two individuals were observed and interviewed, as well as another young woman who had been promoted from the inspection position to the job of sheeter (i.e., operating a straight-cut machine, inspecting the resulting sheets of carpeting, and packing the pieces for shipping). She had worked as an inspector for approximately a year and in her sheeting position for almost a year. All were high school graduates from the immediate geographic vicinity of the plant.

Task analysis of the packer 1 inspector's job indicated that they needed to be able to read and analyze computerized and handwritten customer orders (DOC 5); write labels and add missing information to computerized ones (DOC 5); analyze each piece, determining whether to accept, reject, or fix it (DOC 5); speak and listen to coworkers and others at a simple level (OL 1); and compute or estimate how many boxes could be loaded onto a single skid within the customer's specs (QUANT 4).

However, given how work was organized (or perhaps more aptly stated, how it was actually performed) as a flexible team wherein each individual pitched in and could, if necessary, avoid certain literacy-based tasks, several questions should be raised: Could an employee do this job without reading and writing skills? Yes. Without knowing how to multiply or divide? Yes. Without oral language (English) skills? Not easily, but because of a sample board (constructed by several of the most experienced workers who saw that a visual display of all parts they produced would help in training new workers) and the simple, highly repetitive nature of the job itself, limited English would probably suffice. (No limited-English speakers, however, were found in this job or elsewhere in this area of the plant.)

The inspector/packer who had been promoted to sheeter utilized considerable procedural knowledge in the operation of her cutting machine; she had an assistant (female, hired directly into the sheeting assistant position, though classified as an inspector), whom she had taught the full job so that the assistant could cover during her absence (in which event the new hire at the inspection table served as the sheeter's assistant). Aside from the greater physical and analytical demands of running the machine, the sheeter had considerably more paperwork to complete than did the inspectors. Most of the paperwork consisted of recording data; for example, the daily production sheet required the sheeter to record her/his shift, machine start time, width of the uncut carpet roll, total number of sheets obtained of first quality, number of yards of carpeting used, sheet size, machine downtime, and reasons for downtime. The constant monitoring of the machine's performance and the many manual adjustments required to keep within production specs required much more concentration, analyzing, and problem-solving than did the inspector position. Also required were quantitative skills at a QUANT 6 level. The most difficult computational task for the sheeter involved calculating the number of rolls from a single dye lot required to complete a customer's order. This task required several operations requiring multiplication and division and was performed using a calculator.

Following the line of questioning above, could this job be done with someone who possessed lesser literacy skills? Probably -- while the understanding, analyzing, problem-solving ability would have to be at a fairly high level (though that seemed to be highly procedurally based, i.e., workers were taught these things as they learned the job), the mathematical skill level could be reduced through the use of more carefully and clearly designed production forms. Is the sheeter job more difficult? In terms of physical demands, mental concentration, and psychological pressure, yes; in terms of actual literacy requirements, only marginally -- reading, writing, and computing were used more frequently, but if production forms were redesigned, this job would probably not require greater literacy skills than that of team leader for the inspectors. Could this job be done by someone with only limited oral

English skills? No, but with adaptations to the production forms and limited writing ability, yes.

Competence of Available Worker Pool

Within the company there were different perspectives on the competence of the available worker pool. The plant manager said that many of the people available in the area to hire for factory jobs did not have the basic skills the company would like them to have. As a result, he had doubts about how much longer the company would be able to continue its practice of promoting from within. Of the current shift supervisors, three were hired from the outside. He said that he had seen a relationship between the educational level of workers and their employability skills.

The training director, on the other hand, said that most applicants did have the reading, writing, and mathematics skills necessary to do the job for which they were hired. New hires did not have to do statistical process control (SPC), and training was provided to those being promoted to positions such as operator 3 that require performing SPC calculations.

Perspectives on the Literacy Requirements of Jobs

For the entry level jobs we studied, tender/helper and inspector/packer, the minimum requirement for hiring was that the person be at least a high school graduate. The personnel manager said this was because jobs were becoming more and more computerized and workers needed to learn SPC. At one time Manufacturing Site B did basic skills testing but found that it was not a good predictor of job success. Those that did well on the test didn't stay long on the job. The personnel manager thought that this was because they became bored.

Other Reading Requirements and Training Concerns

Both personnel and training managers stated that English reading ability was essential to the process of training new workers. This was because learning safety information required a lot of reading and writing. The personnel manager reported that new workers consistently had trouble with the new W-4 forms. Materials, such as the health history, benefits information, and applications were often taken home to be filled out. She thought perhaps this was so someone there could help with the paperwork. Our readability formula showed that the mean reading grade level of the employee manual for this company was 12.1.

Initial training involved about two hours to read and fill out employment and benefits forms, become acquainted with the basic job tasks, and learn to read the SOP's. An introductory video tape provided basic information about the company. Another 16 to 48 hours of training, shadowing an experienced worker, were necessary according to the training manager. Workers observed and interviewed in the tender/helper job said they learned the job in half a day. They said they did not need to refer to the SOP. The operator told them what to do.

Safety instruction involved going over the handbook and taking a quiz on the material. Forklift truck drivers had an extensive safety program. The safety engineer found that some people, particularly the older workers, couldn't read the materials. He said the younger ones had been able to read and understand them. The safety manual was written on a 9.6 grade reading level.

To train workers for the operator 1 and operator 3 positions, the training director went through the Operator Training Manual with them. Both positions used the same manual, but the operator 1's were expected to do more. Training in statistical process control was required of those being promoted or hired for these positions.

Training for the inspector/packer's positions was accomplished informally on-the-job; a new worker simply began working alongside the other inspector/packers. (The noise level in this area of the factory was low, so conversational tones sufficed.)

Materials that employees were expected to read outside their own assigned work areas included the employee bulletin board. This was the only place within the plant where new jobs were posted, and the written job notices themselves included selection criteria (e.g., job knowledge/related experience). The board also displayed Teamsters Union notices, company holiday policies, compensation scales, etc. Another bulletin board, entitled "Daily Material Review," contained the minutes of venture group meetings (e.g., details from a waste committee meeting, setting forth new plant-wide policies and noting valuable suggestions made by various named employees); according to the personnel representative, all employees were expected to be aware of these minutes and notices, since new policies were often announced in this way.

Reading Actually Done by Workers Observed

Tender/helpers observed on the non-woven fabric lines said they were not required to do any reading. Their job was to assist the operator in all aspects of running the line and to package and to ship finished fabric. Observation revealed that this work required weighing the finished roll of fabric and reporting the weight orally to the operator, who wrote it on the tag. The tender then wrote the basic information from the tag onto the packaging material before taking it to shipping. Literacy opportunities included reading the work order to determine the color and type of fiber to be used and the desired weight and length of each finished roll. By knowing the length, the tender could check the tachometer so that he could be prepared to assist the operator in doffing the roll. In one instance we observed a tender performing calculations for SPC on a calculator.

Analysis of our observations showed that while most of the young adult population could perform the literacy tasks of the tender's job (copying information from the shipping tag onto the packaging material and reading the weight of the fabric roll on the scales), only about 25% of the population could do the tasks of the operator 3. (This is assuming that our job literacy task items were comparable to NAEP items placed on the same scale levels.)

Employee Involvement and Incentives

Manufacturing Site B had employee involvement groups. These were called venture groups, and gave themselves names like "waste busters". They dealt with specific problems such as packaging, order entry, shipping, recycling. Workers participated voluntarily for 6 months' tenure on a venture group, each of which had an upper management person as a member.

The difference in level of literacy skills and the degree of responsibility between the entry level jobs observed and the next job up was considerable. One tender/helper observed had been with the company 20 years and had been demoted from operator 3 recently because as he put it, "I'm too slow doing the paperwork." Another tender, a young man in his mid-twenties, had no interest in becoming an operator. He said the difference in pay wasn't worth the added responsibility.

Summary

Manufacturing Site B was a rather traditional family-owned enterprise. Management reported that more sophisticated machinery was resulting in an increasing amount of paperwork being required of workers. Perceptions concerning the literacy and basic skills required of workers and the capacity of workers to meet job literacy requirements varied. Management believed that most workers applying for factory jobs and currently employed in his factory lacked skills that would enable them to retain jobs and advance on the job. They particularly cited a lack of the analytical skills required of jobs beyond the entry level. The training director, on the other hand, said that new workers had the skills needed for entry level jobs, and that he could train them adequately for promotion. Entry-level workers perceived of their jobs as easy to learn and requiring little of them. Some had no incentive to be promoted, feeling that the additional money was not worth the added responsibility. We observed that the amount of paperwork, calculations, and the general level of responsibility for the next step on the job ladder for entry level workers at Site B was much higher than for the entry level job. On the other hand, after studying the inspection position and the sheeting job that purportedly represented the natural progression for packer/inspectors (though there is only one such machine in the plant), management's concern that too few of the plant's workers had the analytical skills necessary for more advanced positions seemed rather puzzling. Certainly we observed little need or opportunity to utilize well-developed skills in these two positions. From the cursory interaction with some five inspectors and two sheeters, it seemed that they were all competent, conscientious, and willing workers; they appeared ready and quite able to be trained to do higher level tasks.

MANUFACTURING SITE C

Manufacturing Site C was established in a small New England factory town in 1945. A few years ago, the plant was moved to a new facility on the edge of a rural village near the seacoast with easy access to major highways. The company was purchased by a larger company in 1986. At the time of our visit in the spring of 1989, Manufacturing Site C employed 1000 people in operations in New Hampshire, Virginia, Michigan, and Tennessee, specializing in making rubber weather seals for automobiles. The division we studied employed 170 salaried and 415 hourly employees, most producing automobile glass window run channels (seals around the windows).

In 1984, Manufacturing C initiated a plan to move the factory from an assembly line operation where employees were paid by the piece to a pay for performance job rotation plan. They began by involving volunteers to work within a teamwork concept wherein workers took responsibility for the production work from start to finish, working out their own plans for cutting, molding, inspecting, gluing, and packing the product according to the specifications on the work order. Gradually, the company moved the entire workforce in the glass window run channel division into the team concept.

Entry level workers were required to be prepared by the end of the first year to take a Pay for Performance Evaluation in order to qualify for their jobs as core operators. Management reported that only three or four workers were unable to pass their initial certification. Core operators were recertified once a year by being assessed at successfully completing the tasks outlined in the Pay for Performance Manual.

Two observers followed a team of twelve workers at this site, interviewing and shadowing four experienced workers and two novices. We also interviewed two advanced operators, one who had recently passed her pay for performance examination in troubleshooting. The second passed hers in quality control during the week we were on site. The team planned a cake and celebration for her one early morning after work.

Organization of the Work

The work was organized into several work cells that functioned as separate production units. It was divided into cutting, molding, and finishing operations. Core operators had to know how to set up dyes and presses. They were also trained to perform and document the OSHA safety checks of the presses -- a two-minute procedure to be done once a week. They knew the gauging requirements, were familiar with the fiber optics gauge, and knew how to do cause and effect problem solving related to the Statistical Process Control Charts. They also were required to perform quality control inspections and samplings.

The molding operation included the process monitoring SOP, which showed the locations on the mold that had to be measured at a given time. Pressure gauges had to be read and monitored to be sure the machine was operating within the temperature and pressure specs. The core operators were responsible for keeping the machine within the required settings. If the machine were functioning within these limits, yet there continued to be a problem in getting a quality product, the core operators performed basic cleaning and maintenance procedures. If a problem persisted, an advanced operator was called in to troubleshoot.

Finishing operations involved gluing, packing, and final inspection. A final audit and inspection of the product could only be performed by team members who had passed their core operator evaluation. The quality team representative calculated the team's performance rating each week: materials efficiency, labor efficiency, quality, and cost. A sample board showing quality parts at each stage of production was maintained by the team representative.

Five team members performed functions as team representatives (reps.) for three month periods. These functions were rotated among team members and included technical rep., quality control rep., housekeeping, and safety rep., cost control rep., and general team rep. We interviewed workers holding each of those positions to learn the responsibilities required of them. Teams were required to prepare their own job rotation schedules, set ups, break downs, and quality control. Some teams did their own hiring. There were weekly team planning meetings during working hours for the teams on each shift. The team reps reported the team's performance in the functions for which they were responsible, and the team decided together how to address any problems identified.

Nature of the Workforce

The workforce on second shift was made up largely of people ranging in age from their mid-twenties to their mid-forties and about equally divided between women and men. The team we observed had twelve members, six of whom were Southeast Asian.

Competence of available worker pool

In the glass window run channel department, there were 600 workers. Two hundred-fifty to 300 workers were currently certified as core operators. Five percent of these were engaged in training as advanced operators. According to management, 60% of core operators will never try to advance to the next level. The supervisor reported that the shop has been running short of advanced operators. Management would like each work cell to have 20% of its workers at the advanced operator level.

The real test of workers' competence was whether or not they could perform the tasks required in the Pay for Performance Manual. Since there were few failures, management concluded that the workers hired had the requisite skills needed.

Perspectives on the Literacy Requirements of Jobs

Although no basic skills testing was conducted during the hiring process, personnel staff insisted that applicants filled out their applications in the building and used their performance in filling out the form as an assessment of the applicant's literacy skills. Personnel also reported that they no longer had a large number of applicants who lacked the basic skills required, saying, "Today word is out that you have to be able to do basic computation, fractions, decimals, and be able to read and speak English to work here." A prerequisite to hiring was an intermediate speaking ability and a beginning writing ability in English, according to the vice president for Human Resources.

Other requirements for the job included teamwork skills. The ability to work with others was essential, and personnel staff said that new workers who had difficulty in that area usually left the company. When interviewed before leaving, they often reported having had trouble working with others all through school, and said that their teachers just left them alone if they were having such problems. The supervisor of the team we observed oversaw four teams of about ten people each on the 4 pm to 2 am shift. She said that group process skills were the most difficult skills required of workers. Two of her teams worked very well. Two she described as "non-teams."

In the course of observing and interviewing workers, we learned that from the perspective of the team members, there were very definite values assigned to certain competencies and behaviors. The ability to see what needed to be done and do it was deemed important. There were complaints about team members who did not move to another position to assist a team member having difficulty or getting behind. People who were unable to see where others needed help or who did only the work assigned were considered lazy or seen as not caring about the team. Similarly, team members who did not offer ideas during team meetings were seen as indifferent or ineffective.

Further probing of this issue made it apparent to us that most of the complaints were centered on the behavior of the Southeast Asian team members. Our experience in cross cultural issues in the workplace led us to believe that some training in cross cultural understanding would benefit this team and improve its functioning. What constitutes a good worker in Southeast Asian culture, the expectations for proper relations between worker and supervisor, male and female, are all very different from what is expected by American teammates in this setting. For example, in Southeast Asia to show respect to one's supervisor, one does precisely as one is told and does not encroach on others. Some Southeast Asian workers gave signs of anxiety that we interpreted as resulting from unconscious differences in cultural expectations surrounding work. Since we observed Southeast Asian workers performing competently at their assigned tasks, we had no reason to suspect that lack of basic skills was an issue for them.

Other Reading Requirements

Manufacturing Site C provided written materials such as an employee handbook, company insurance and benefits information, and OSHA safety information. Reading requirements during orientation were kept to a minimum, with safety information communicated orally and through the use of videos. Personnel staff provided a two hour orientation to the benefits package as new employees become eligible for benefits (after three months with the company). The personnel staff were of the opinion that workers needed to read the information about their medical, dental, and life insurance benefits themselves to make informed choices. Thus after the orientation, workers took the benefits material home, returning to personnel within 30 days with their decisions. This approach permitted the workers to get help, if necessary, in reading the benefits information. Since our readability analysis showed the Health Insurance

Booklet to be at reading grade level 12.2 and the Group Insurance Plan to be at grade 11.4, it is likely that the average entry-level employee would have some difficulty reading them.

The Pay for Performance Manual and group process training materials were much more accessible to workers. The manual was written at a grade 8.9 level. Group process training materials that workers were expected to read were translated into Lao to make them more readily understandable to the largest group of the Southeast Asian workers at the plant.

Training Concerns

As the company began implementing the team production concept back in 1984, personality conflicts and disagreements among workers at the outset prompted management to bring in a consultant from the state university to set up a training program in group process, communications, and conflict resolution. That consultant trained in-house trainers to continue this training. At the time of the site visit, everyone who began work at Manufacturing Site C was given six hours of communications and group process training. This included material on how individuals function in groups and on group consensus seeking activities.

Training in statistical process control was done by the team supervisor in a classroom setting. Other job-related training was done on the job. Two workers, an experienced worker and a trainee, were paired until the trainee had mastered the new task requirements. Team rep. tasks were often the most difficult to master. Training for these was provided by the advanced operators or supervisors.

Advanced operator training included extensive course work. The statistical process control training was 13 weeks in length. Other required courses were rubber technology, trouble shooting methods, basic algebra.

Reading Actually Done by Those Observed

The job literacy task requirements at Manufacturing Site C were considerably higher than for those of the other three manufacturing sites visited. All entry level workers were required to perform SPC, to order materials using computer software, and to fill out quality control data charts and the like. Oral language requirements and interpersonal skill demands were at a high level because all workers were required to participate in team meetings on a weekly basis and to work as a team on the job. Certification in teamwork skills was a prerequisite to being certified as a core operator. In addition, all workers were required to learn the skills required to serve as team representatives (reps). These included reporting the team's cost effectiveness, quality control problems, housekeeping performance, and so on, at each meeting.

The most difficult reading tasks for the core operator at Site C involved ordering materials or filling out SPC charts. Both tasks involved 4 or 5 feature matches, often with several exemplars, placing them near the top of the document literacy scale (DOC 6). The most difficult computation tasks entailed more than two operations with at least one involving multiplication or division, and requiring a feature match (QUAN 6), the highest rating on our scales. Prose tasks required for documenting problems with out of spec parts and entailed writing several sentences, pulling together information about the process used to analyze possible causes for the problem and to arrive at a solution. We placed this task at 3c on the prose scale. Oral language skills regularly involved narrating information and persuading teammates of one's point of view (OL 3). Thus, the most difficult literacy tasks for this job were at or close to the top of the rating scales.

Interestingly, Manufacturing site C reported having very few entry level workers unable to pass their Pay for Performance evaluations. The scoring criterion for the evaluation was "an average score of 100 percent for each operational section. One miss is allowed in the Efficiency to Standard Section." (Pay for Performance Manual, Manufacturing C.) We did not have the opportunity to assess how those administering the evaluation made scoring decisions. In terms of how workers learned difficult tasks, we theorized that they tended to be assigned to or gravitate toward tasks at which they were most competent, and those who were most skilled assisted in training those less capable.

Commitment to Worker Involvement

A distinctive feature of Manufacturing C was the commitment management made to implementing the innovative manufacturing practices described above, and their concerted efforts to maximize the potential of entry-level workers to contribute meaningfully to the organization. Team meetings and on-going worker training were conducted on company time. We saw evidence that such a commitment was paying off for the company. At the team meeting we attended, workers decided to forgo their first break of the shift because they were behind in their production schedule.

Summary

Manufacturing C is a good case for showing the impact of state of the art management practices on the literacy requirements of entry level jobs and the commitment management must make to training in order to implement such practices. Not only were the document reading, computation, and writing skills the highest found at any manufacturing site studied, they were also of comparable difficulty level to the most complex entry-level hospital jobs observed. Everywhere in manufacturing, management emphasized the importance of being able to team effectively with other workers. At this site, team work skills were a requirement for job certification and considered essential to continuing on the job.

HOSPITAL SITE A

Hospital A was a large, prestigious hospital located in a metropolitan area in the Northeast. It had 1,082 beds and employed 10,000 workers. We observed nutrition assistants in the dietetics department and laboratory assistants in the chemistry laboratory of the hospital.

The dietary department served 700 to 750 patients at every meal from two kitchens. The nutrition assistant's job was similar to the diet clerk position at Hospital C. While it was an entry level job, it was rated in a higher job category than the food service aide job. It was possible for food service aides to be moved into the nutrition assistant position, but none had done so since the job was upgraded in 1986. The job now involved computation as well as reading, writing, and interviewing patients. One of the three nutrition assistants we observed said she believed that some of the food service aides had the potential to do her job but were intimidated by the calculations required and, therefore, would not consider applying for it.

The chemistry laboratory employed some 77 people, 10-13 of whom were lab assistants (the entry-level position within the department). The lab assistant's job "was at the heart of the lab," according to the lab's manager. Work was intense and exactitude was required. The lab assistants received specimens and test requisitions, assigned accession numbers, logged the orders into the lab's computer system, centrifuged and decanted specimens, prepared slides. Thus, they generally did all the preparatory work required prior to actual testing operations (which were done by licensed med. techs, a position requiring a 4-year college degree and 1-year formal apprenticeship). They also conveyed test results by telephone and by computer printout to an extensive list of wards, clinics, and private physicians. The lab processed some 1500 requisitions daily, though the number of tests was much greater, since a single requisition could order many different tests. Not only was the volume of testing great at this lab site, but also the breadth of testing: lab assistants had to be familiar with prep procedures for over 150 different tests. The intent in the near future was to expand the testing range even further, reducing to a bare minimum the number of tests sent to outside labs (and thereby reducing lab charges to patients and the turnaround time for test results).

The lab was equipped with state-of-the-art equipment, housed in newly renovated space designed to accommodate the expanding workload of the department. Its current computer system would be replaced by a more sophisticated one during the coming months. As with the new space redesign, computer system features were largely being created by lab staff, and lab assistants had enjoyed input into these changes.

Hospital A's personnel department provided preliminary screening of all applicants. During interviews, personnel specialists tried to ascertain the strengths and weaknesses of applicants in order to identify the job best suited to the applicant. They wanted as far as possible to ensure that applicants be placed in jobs where they could succeed. In general, they observed how applicants filled out job applications, especially looking for accuracy and completeness. They wanted applicants to fill out the application form rather than just attaching a resume. Different personnel staff members generally recruited for different departments. In screening applicants for the laboratory assistant's job, personnel looked for people with good interpersonal skills who were well-organized, detail-oriented and able to work at the pace required of that job. They assessed those skills by examining the quality of the worker's application and checking references. During the interview they asked questions, such as, "Are you the type of person who likes to juggle 10 balls at a time?" Responses to such questions helped personnel determine whether the applicant was comfortable with the intensity of the work likely to be experienced by lab assistants.

Applicants for the dietary assistant position had to possess good interpersonal skills. Their job entailed interacting with patients as well as with dietary aides, nurses, and other floor staff, working with them to ensure that the patients were provided the best nutrition possible.

Dietary assistants were also required to have math skills, reading skills, and organizational skills. For this position, the personnel department used a pre-screening interview, which included a test of their knowledge of fractions and decimals, word problems involving calculations used in the dietary department, such as multiplication and division of fractions, decimals, and rounding numbers to the nearest decimal point. Applicants were also required to use the Menu Guide as a reference to look up information needed to solve one fairly basic problem.

If applicants passed that pre-screening, they were interviewed by the manager of the Department of Dietetics. During this interview they were also given a written test. The department manager said that she was careful to prepare interviewees for the test by telling them she was available to answer questions and stressing that to ask questions would not be considered a liability. Since working closely with and asking questions of the registered dietitian was an important skill for the nutrition assistant, some tasks on the test deliberately left out essential information. Those screened for the applicants' ability to perceive the need to ask a question and their willingness to do so. The test incorporated several of the actual job tasks required of nutrition assistants. For example, interviewees worked from a sample daily menu to select the foods necessary for a high ph diet (the simplest diet prescribed). They were also asked to make out a diet change order sheet, which involved recopying the final sheet from the previous day onto a new form for the next day, taking into account the indicated changes. The purpose of this activity was to determine whether the applicant could conceptualize what had occurred, since this task was considered one of the more complex required of nutrition assistants. It also enabled the director to check the legibility of the applicant's writing. Prior to the time when personnel began giving a pre-screening exam for the nutrition assistant's job, applicants who did not have the necessary skills were sometimes sent to the dietary department for interviews. This was no longer the case.

In addition to the above requirements, all employees were required to pass a hospital physical. The nutrition assistant's job entailed a lot of walking and standing and some carrying of food, hence physical stamina was needed to do the job.

Organization of the Work

The Department of Dietetics was made up of the department manager and her assistant, who is a registered dietitian; the registered dietitians; and group leaders who supervised the nutrition assistants and food service aides. Nutrition assistants worked closely with dieticians, who checked their work and consulted them about patient needs. Each assistant was responsible for three floors (about 90 patients). The group leader we interviewed had worked as a nutrition assistant prior to being made group leader. She had been employed for 15 years prior to that as a food service aide. She considered her supervisory responsibilities the most difficult part of her new job.

Work for lab assistants was organized around five workstations (coinciding with the first 5 tasks in the job task analysis). All lab assistants were expected to know all that was done at each of the tables, with the exception of the send-out table, which until now had been reserved for only the most highly experienced. To break up the day and evenly distribute workloads, a weekly schedule was posted providing for rotation of employees: each employee worked 1/2 day at a different workstation. While employees were permitted to swap assignments, they rarely requested to do so. Each workstation was staffed in two's and three's, so that strict adherence to uniform procedures and good interpersonal communication skills were musts. And although the lab assistants performed their tasks within these small groupings, they nevertheless performed as one large, harmonious team: each workstation kept abreast of the progress and problems of the others, and it was not uncommon to see one or more lab assistants quietly move from their assigned group and to another workstation and spend a few minutes helping the others keep pace with the workload. Supervision consisted of one med. tech. who was in turn supervised by the lab managers. The need for supervision, however, was minimal, and both supervisors primarily served in resource roles as problem-solvers and testing experts.

Nature of Workforce

Most of the entry level workers in Hospital A's dietary department were African-American women, as was their group leader. Staff ranged in age from young adult to late fifties. Not all of the successful nutrition assistants were high school graduates and not all had GED's.

All lab assistants at Hospital A were women, except for one man (who appeared to be in his early 50's and had worked there over 10 years); at least half were minorities. Job turnover within the lab was extremely low. Except for one new employee, who was only beginning the 3-month training cycle during our study, the lab assistants ranged in years of tenure from 2 1/2 to 12. Of the three lab assistants observed in this study, two were in their early 20's and the third was in her early 50's; they had been employed in this lab for 2 1/2, 4, and 12 years, respectively. Their educational backgrounds included 8-month and 2-year medical assistant training programs at proprietary schools for the two younger workers. The oldest worker observed was a high-school dropout and was clearly recognized by supervisors and peers as one of the department's most experienced and competent lab assistants. Also interviewed was the department secretary, who had formerly served as a lab assistant for 11 years. (Hers was not a career-ladder promotion, but it was the only applicable position at this site.)

Competence of Available Worker Pool

The director of the Department of Dietetics believed she was currently hiring workers competent to do the work required. This was not always the case before pre-screening was instituted. The assistants themselves seemed confident about their ability to do their jobs. The department's director said that one recently hired dietary assistant could do all the math well and had good organizational skills, but she noticed during a training session that this trainee had a problem reading the Dietitians' Manual aloud. This caused her to have concerns about the trainee's reading skills. Thus far the new worker's job performance had proved satisfactory.

The chemistry department preferred to hire lab assistants with a minimum 2-year technical school background. Because of local labor market shortages, however, they had successfully deviated from this policy and had hired less well-educated persons who seemed to possess other required work traits: e.g., attention to detail, congeniality, ability to work well under pressure, reliable attendance, and willingness and ability to learn the ever-changing procedures and equipment. Based on lab assistants' and supervisors' accounts and our own observations, lab assistants at Hospital A were required to concentrate closely on what they were doing approximately 85% of their total work time. Thus, the lab assistant position required the ability to: a) steadfastly focus on task for long periods of time and under considerable pressure (all were adamant that "auto pilot" performance in this lab environment did not and could not occur); b) memorize and perform detailed specimen preparation procedures for over 150 tests, keeping up with an ever-expanding list of tests and constantly-evolving testing requirements and adhering to strict precautionary rules for safe specimen handling; c) understand the limits of one's own knowledge and training, and raise questions immediately upon suspicion that something differs from the expected norm; and d) be able to interact well and in close proximity with many kinds of people.

The pre-screening of job applicants by the Personnel Department, together with the careful interviewing of candidates by the department manager, seemed to have been very successful. In pre-screening, the Personnel Department also made certain that applicants could touch-type a minimum of 30 wpm (because of the computer keyboard skills required in the lab), were not squeamish about handling blood/urine/stool specimens, and understood that once on the job, they would be required to learn long lists of technical terms, test requirements, and other abbreviations that initially might have little meaning for them.

Perspectives on the Literacy Requirements of Jobs

The director of the Dietetics Department realized that the nutrition assistant's job required a fairly high level of reading and computation, but believed that workers currently being hired were successfully learning to perform their jobs well. They performed many tasks that were once required of the dietitian, but their work was all checked and signed off on by the registered dietitian assigned to their floors. All those interviewed, both supervisory staff and nutrition assistants agreed that the most difficult tasks of the job were copying over the information from the diet change board to the appropriate form. They reported that there were many details and changes to be dealt with and no systematic set of abbreviations used by floor staff. Everyone, therefore, handled this information differently. This was particularly confusing to new workers, especially since the activity was usually the last one done in the day, often in a time crunch. Another required literacy task involved the patient intake/output document. It was difficult for a similar reason -- no standard abbreviations for chemical formulas, tube feeding formulas, and special diets.

In the chemistry laboratory, we found that supervisors and lab assistants were not in complete accord concerning the literacy requirements and difficulties of the job. One lab assistant found the interaction with wards/nurses/physicians phoning for test results to be the most frustrating part of her work; another identified the computer logging-in system to be difficult to learn; the high-school dropout found none of it very difficult, while noting how essential it was to concentrate on the task. All agreed this job required solid reading, writing, speaking, listening, and analyzing skills. It would not be possible for one employee to cover for another's lack of basic skills. Indeed, the lab assistants took their job very seriously: one of them noted that "we save lives." They seemingly demanded of themselves the highest possible standards, and based on our observations, it was unlikely the group itself would tolerate a lab assistant whom they perceived to be deficient in any skill area.

Other Reading Requirements

Reference materials were used during training and also on the job to look up information on less familiar diets. The Policy and Procedures Manual for Clinical Dietetic Activities was found to have a mean reading level of 11.5 using the FORCAST readability formula. Unfortunately, the beginning sections of the book were nearly two full grade levels higher than the ending sections (12.4 as compared to 10.6). Considering that most young adults entering the workforce read on a 9th grade level or below, this was difficult reference material for an entry level job. Most frequently an abbreviated form of the manual was referred to, but at times the manual itself was used for reference.

Training Concerns

The hospital provided a number of courses, either free of charge or for a low fee. These included working with personal computers, management skills, and English as a Second Language. New nutrition assistants were trained on the floor with an experienced worker for 2 days, then given 3 days with the food services supervisor. They then returned to the floor for another week and one-half with the nutrition assistant who was training them, before taking over the job themselves. There was also a more extensive training several weeks in length held in a classroom setting. This was offered periodically whenever there were enough new workers to warrant holding the course.

The chemistry lab provided a 3-month training cycle for new lab assistants. Using the lab procedural manual as a guide for all that must be learned, the new employee was initially assigned to the logging-in computer workstation. For this task the lab assistant must know all the test preparation procedures for all the tests done by the lab and must also fully understand the documentation procedures required within the lab. This workstation constituted the central stage for training. An experienced lab assistant trained the novice, and staffing at that workstation was adjusted so that the trainer and novice were relieved of the usual time pressures for that station. An attempt was made to manipulate the new employee's exposure to various kinds of tests (i.e., within the constraints of the test requisitions being received by the department, they tried to have the novice learn only a few tests at a time and to reinforce this learning by directing all requisitions for those kinds of tests to her). After some 2 months of learning in this manner, the new employee was then rotated for a week at each of the other workstations, again working alongside an experienced employee. After the training cycle was completed (while it was intended to require only 3 months, sometimes training required less time and for other learners, it sometimes took longer), the new employee continued to be very closely supervised by experienced lab assistants, who also audited the novice's completed work. Such supervision continued until it was clear (to co-workers and lab supervisors) that full competency had been achieved.

The lab conducted a 1-day safety seminar for its employees each year; attendance was mandatory. Training on new instruments and computer equipment was incorporated into the weekly work schedule, with such training consisting primarily of one-on-one peer instruction.

Reading Done by Those Observed

As has been mentioned above, the nutrition assistant's job involved constant reading, writing and computation. Attention to detail in filling out forms was very important, although all work was checked by the registered dietitian, who had ultimate responsibility. We noticed that the recently hired worker had to check reference materials more frequently than did the two experienced workers, who had memorized the most common diets and the nutritional values of most foods appearing on those diets. Analysis of literacy tasks performed by the nutrition assistant placed them at the top of our rating scales at DOC 7 and QUAN 6. The oral language skills involved were also at the top of our scales, requiring persuasive as well as narrative and informational speech and careful listening.

A lab procedural manual was located in the manager's office and could be consulted should lab assistants wish to do so. In actuality, however, it was used only for guiding training. When questions arose, they were directed at the most experienced co-workers and/or at the supervising med. tech. and/or the lab manager. (The latter two individuals coordinated their other responsibilities so that one was always within the department and accessible for questions and trouble-shooting.)

Other written materials, used as crib sheets and reference manuals for test preparation and send-out requirements, were essential reading accompanying many job tasks. All work-stations were observed to have crib notes attached to desk surfaces and/or nearby walls; some of these notes were handwritten by employees, others were printed instructions, notices, addresses, or specs. All lab assistants were observed using these notes, as well as the reference manuals located on the numbering and the send-out tables. The manuals contained preparation requirements for various tests, other names by which tests were known, the kinds of results that could be obtained from different tests, the costs of tests, and the names and addresses of outside labs that processed each test. Yet their use was as an essential reference, not as a reading-to-learn instructional guide. Without prior training in these procedures, the notes and manuals would be of little assistance or meaning. Thus, experienced workers made good use of crib notes and manuals, whereas novices would have to rely upon asking and listening in order to know where to look and how to interpret such reference tools.

In performing the job, as was evident from the task analysis, lab assistants carefully read and decoded, wrote and encoded, and analyzed specimen labels and various computerized test logs. By the end of the 3-month training cycle, a novice was able to perform these tasks, though not with the proficiency and level of accuracy of an experienced worker. Even an experienced lab assistant, however, read each line as carefully (and with full concentration) as a novice. The lab assistants' most difficult literacy tasks, like those of the nutrition assistant at Hospital A, were at the top of our scales of literacy task difficulty.

Unique Features of This Site

Of the three hospital sites visited, this one required the highest skill levels of its nutrition assistants. In looking at the job description of the dietary assistant at Hospital B and in observing the diet clerk (dietary assistant) at Hospital C, we concluded that these jobs in other hospitals were largely clerical. At Hospital A, however, the nutrition assistant did much of the work of a registered dietitian. The dietitian basically prescribed the diets for the patients, but the assistant implemented the diets, which entailed doing most of the calculations and paperwork required to ensure that the patients were actually receiving the prescribed nutrition. Furthermore, the assistant did much of the problems solving, identifying alternative foods for patients who were having a difficult time in taking in the nutritional elements necessary for their diets.

It appeared that local labor market conditions impacted on both jobs studied at Hospital A. We were aware that the hospital was attempting to reduce labor costs. Just prior to our visit, a sizable number of layoffs had occurred. We speculated that passing much of the paperwork of the registered dietitians on to an entry level employee enabled the hospital to reduce the number of highly paid dietitians on staff, thus reducing payroll costs. The high demands of the laboratory assistant jobs seemed to be the result of a shortage of trained laboratory technicians and med techs.

Summary

Hospital A employed a very large workforce. Personnel screened job applicants extensively, and having a large metropolitan area to draw from, was able to work to match worker skills with job requirements. Both of the entry level jobs studied at this site required fairly high literacy levels, enabling the hospital to reduce the numbers of professionals with degrees hired to do the work. In both jobs, workers did much of the paperwork required of the technical people they assisted, thus saving payroll expenses for the facility.

Workers in training did more reading of reference materials than did trained workers, although both were required to refer to such information frequently. In both jobs, a high level of accuracy in doing paperwork was required and good teamwork and interpersonal skills were essential.

HOSPITAL SITE B

Hospital B was a 598-bed non-profit general hospital located in a medium-sized New England city. Serving as both a tertiary care community hospital and a major referral facility for an extensive rural area, it employed some 3,400 people doing over 460 different types of jobs, making it one of largest employers in its region. As with the other two hospital sites, RMC Research observed two job types: laboratory assistant and dietary aide. Neither of the jobs observed was unionized.

Organization of Work

Laboratory services at Hospital B were organized under the Department of Pathology, which centrally provided all phlebotomy services, specimen/test requisition logging-in activities, and laboratory computer systems operation. Basic test analyses were conducted by a few small labs, which represented the various clinical medicine disciplines. Observed in this study were three of those labs--Microbiology, Chemistry, and Immunoassay. Each was staffed by one lab assistant and a combination of medical lab. technicians and medical technologists (license staff who hold 2- and 4-year degrees, respectively, plus apprenticeship training), as well as lab. tech. and med. tech. trainees.

How work was organized within each of the three labs differed, depending on the kind and volume of tests performed, the equipment required for testing, and, certainly to some extent, on the nature of the lab assistant's own interests and abilities. Although the labs were few in number, small in size, situated in close proximity to each other, and managed by the same pathology administrative unit, none of the three workers knew much about the others or what duties they or other lab assistants performed in their respective labs. It was found, for example, that 100% of the microbiology lab assistant's time was spent in clerical administration, whereas 75% of the chemistry lab assistant's work was clerical and 25% involved specimen preparation, while the immunoassay lab assistant generally spent half her time on clerical duties and half on specimen preparation. It also became apparent during the course of observations that each had devised different ways of accomplishing the same basic administrative functions. The microbiology lab assistant observations, which were conducted first, provided the best understanding of the basic tasks at Hospital B would be expected to perform.

The kitchen produced approximately 3,000 meals a day, servicing both patients and staff. A basement-level store-room and modern cook-chill facility was the engine that provided the food for the hospital kitchen above it. That kitchen housed a tray assembly line, a formula laboratory for special diet preparation, and dish and pot washing facilities. Dietary aides worked in all areas: specific posts included stocking shelves, servicing the cook-chill area, food preparation, dish and pot washing, serving on the tray preparation line, and food delivery. Ideally dietary aides were able to work at any position, but in fact only a minority of them could do so, and some workers were assigned to positions that require minimal literacy skills.

The extent to which workers were assigned to job tasks on the basis of their abilities, and their literacy skills in particular, made selection of positions to be observed a critical element in the study. After a tour of the entire operation, workers who occupied posts that appeared to require the highest literacy levels were selected for observation. These included dietary aide - utility, a single person responsible for cutting and weighing meats and other products for cooks in the lower kitchen, and dietary aide - team. This team of aides under the leadership of a dietary assistant was responsible for delivering food to patients on the floor, and had to be familiar with universal procedures for handling hazardous materials such as blood.

Administrative tasks at this hospital were highly computerized. Laboratory assistants utilized two computer systems, an internal lab system and a hospital-wide MIS system. Two terminals sat on their desks, and both were highly utilized. Indeed, an estimated 80% of all clerical/administrative duties performed by the lab assistants were computer-based (telephone answering took up another 15% and only 5% remained paper- and pen-based). Given the fact that a high percentage of the lab assistant's time was spent doing clerical work, the importance of computer literacy skills at Hospital B should be apparent. Furthermore, because there was limited interface between the two computer systems, the lab assistants spent much time comparing, verifying, and correcting data between the two. Understanding what data were automatically transferred electronically, how to detect errors and inconsistencies and how to determine the valid data, all seemed to add an analytical challenge beyond the limited knowledge of hardware, software, and lab procedures required for data entry, correction, and retrieval.

Nature of the Work Force

Hospital B was situated in a growing community with a relatively tight labor market, yet the hospital was able to attract applicants both because it was widely recognized as one of the major employers in the region and because it was able to offer competitive wages. Among laboratory assistants, a small staff and low turnover (the newest hire had been working at her station for one and a half years) meant there had been no immediately obvious recent changes in the nature of that workforce. All three lab assistants observed were white females; two were in their early 50's and one was in her late 20's. Of the older women, one had worked for the past 8 years in the lab, but had been with the hospital for over 17 years; the other had worked at the lab only some 18 months and for the previous 14 years had been a regional manager of a small rental company. The third woman, who had been at the lab 16 months, completed 2 years of college (in elementary education) prior to this job, and in the future hoped to continue her studies in an area related to her lab work. All three received on-the-job training. They worked alongside their predecessors and/or supervisors as they were taught various tasks. The two lab assistants who handled specimens were taught preparation procedures by med. techs. and/or supervisors (who were also med. techs.) as the occasion arose -- i.e., when assistance was necessary in keeping up with specimen preparation and/or when the lab assistants had free time after their clerical responsibilities were completed.

The volume and quality of applicants for entry-level jobs in the kitchen had decreased over the past several years. The workforce here was generally younger and more mobile than in the past, with a core of staff who had been in the same positions for many years and were not in line for promotion. The full-time workforce was supplemented with part-time high school students who worked in the late afternoons or early evenings.

The personnel department screened applicants for lab assistant positions, looking for candidates capable of sustained periods of concentration and close attention to detail; candidates were also required to have a high school education (or equivalent) and solid reading and writing skills. Lesser requirements existed for dietary aides. One dietary aide was from a sheltered workshop. In the words of a supervising staff person, "They should be able to read a little." Yet inadequate reading skills precluded dietary aides from promotion.

Perspectives on the Literacy Requirements of Jobs Observed

The two types of jobs observed differed in both the literacy levels required to perform them and the extent to which literacy was required of all with the same job description. All laboratory assistants observed were required to perform multiplication tasks. Only those dietary aides assigned to the more difficult positions needed do so. The laboratory assistants constantly used their reading skills, entered data on computer terminals, and used considerable procedural knowledge to do so. The most difficult aspect of the lab assistant position -- as reported by all three lab assistants and the lab's assistant administrative director -- was understanding the two computer systems and their interaction; a close runner-up, more in terms of frustration/stress level than difficulty, was telephone interaction with wards/nurses/physicians who phoned for test results, many of whom, it would seem, lacked basic telephone courtesy and/or a general understanding of how the testing procedures were done and the time required to do them. The dietary aides did not need the same procedural knowledge nor the extensive medical vocabulary the laboratory assistants were required to learn. Finally, change was an integral part of the laboratories where procedures were often changed or tests added. Changes in procedures did not appear to be common in the kitchens.

Other Reading Requirements and Training Concerns

The Employee Handbook was written at approximately a 12.1 grade level. This was well within the scope of the laboratory assistants, but undoubtedly difficult for many dietary aides. We analyzed one readability of the hospital's edition of the regular weekly newsletter, **What's Happening**. It was written at approximately a 10.7 grade level. More importantly, the hospital's instruction manual on chemical hazards was written at approximately a 12.3 grade level. The staff person responsible for ensuring dietary aides were aware of OSHA guidelines to hazardous chemicals reported that although employees were required to sign verifying that they understood the labelling system for hazardous chemicals, he doubted that many comprehended them.

There was no formal laboratory procedures manual to assist the learning process of lab assistants; rather, as previously indicated, training was accomplished by working alongside an experienced individual, such as one's predecessor, a med. tech., or the supervising med. tech. i.e., by observing how the task was done, and then being "talked through" the task and repeating it as the other person supervised, until both were certain that the task had been learned.

Such training, in these labs, was reportedly rather ad hoc, driven primarily by when there was available free time and when a particular task had to get done, rather than by any systematic program built on sequential learning principles. For new employees, pathology lab management offered a seminar on lab organization, safety matters, lab policies (e.g., patient confidentiality), time cards, etc.

The most experienced of the laboratory assistants observed in this study reported that a couple of years ago, she greatly profited from a semester-long medical terminology course offered at the hospital by a local college. (It was no longer offered.) Even though she had already been working in the lab position several years, it helped her learn additional medical terms, test result components, and standard abbreviations. It also helped organize all that she had already learned about hospital lab operations and the concepts and meanings underlying the vocabulary she had already constructed on her own from the words she encountered daily on the job. From discussions with the other two lab assistants, it would seem that such a course should be considered an essential component of lab assistant training; certainly no on-the-job mechanisms were found for formal learning of this nature.

Reading Actually Done by Workers Observed

Laboratory assistants were constantly reading menu-driven software, reading computer printouts to retrieve information requested over the phone by physicians, or reading orders for tests. They also had to read abbreviations of test names and orders hastily scribbled onto order forms by laboratory technicians. Other than notes they may write for themselves to ensure they remember procedures for entering data or setting up tests, most of their writing tasks required them to enter prescribed data in response to prompts on computer screens. Most of the speaking they were required to do consisted of asking questions about new procedures they were learning. At times they also needed to negotiate with their supervisors, the order in which they would complete assigned tasks, in order to meet the sometimes hectic demands of the work schedule. The most challenging listening still required dealing with demanding and sometimes impatient physicians telephoning for results to tests.

Lists of goods, order forms and menus made up the bulk of the documents read by dietary aides. Writing consisted primarily of labelling foods with a name and date, or writing in numbers (such as the temperature of a food) and the date in a log book. The majority of work-related spoken interactions were purely for communicating factual information, although dietary aides working in the hospital wards who could interact effectively with sick, and sometimes demanding, patients were prized.

If it had been possible to relate the most difficult tasks required of dietary aides to the literacy tasks on scales established by NAEP, between 83% and 91% of 21 to 25 year olds in the nation would be able to complete the reading tasks required by the job, and less than a quarter of the same group would be able to complete the simple multiplication tasks required by the job. The percentage of the same population able to successfully complete the tasks equivalent to those expected of laboratory assistants was much smaller.

Summary

Hospital B's dietary department had responded to a diminishing pool of qualified workers by breaking the dietary aide job into a number of positions at which workers performed a well-defined series of repetitive tasks. Most positions required little by way of literacy, although the requirements of those interacting with patients were relatively high. Laboratory assistants were challenged by the complexity of the hospital's MIS system and by the non-uniform use of terms and abbreviations on laboratory test orders. They were also required to have good interpersonal skills, having to interact with both medical and laboratory staff.

HOSPITAL SITE C

Hospital C was a 125 bed county hospital located on the West Coast. As a county hospital, most of the patients it served were on medi-Cal or medicaid. The hospital also had the trauma unit for the county, an intensive care unit, medical and surgical wards, a locked psychiatric ward, and a prison ward. There was no pediatric unit; children were treated only on an emergency basis. Most patients were between the ages of 30 to 50. An affiliated nearby facility served geriatric patients and other patients requiring extended care. Many patients were Latino, East Indian, or Pacific Islanders. This affected the menu and the dietary preferences of patients and the languages in which hospital staff were required to interact with patients.

The hospital kitchen served 2500 to 3000 meals a day. It sent meals to the extended care facility, to the country senior nutrition program, child care program, and served 250 staff daily in the hospital cafeteria. We observed two experienced diet clerks (dietetic assistants) and one new worker as well as three different dietary aide positions in the kitchen: those judged by the supervisor as demanding the highest literacy skills. These included snack preparation, dessert preparation, foodlines, and special order preparation. Three experienced workers and a worker being cross-trained were observed in the dietary aide positions. There were no recently hired workers available to be observed.

Eight labor unions operated within the hospital. None of the dietary positions we observed were unionized, but the laboratory assistants were members of AFSCME. The hospital's laboratory provided chemistry, hematology, bacteriology, microbiology, blood bank, and phlebotomy services to all wards of the hospital, including the emergency room, jail, and morgue, and to a sizeable outpatient population, an affiliated rehab center, and several neighborhood clinics. With a total staffing of only 28 FTE to provide 7-day around-the-clock coverage, lab employees worked together quite closely and frequently "wore different hats" in order to keep abreast of the patient workload. This was particularly true of the three lab assistants who, together with one to three medical technologists, staffed the central lab area and routinely interacted with patients. All three lab assistants were observed in this study.

Organization of the Work

The chief dietitian was the administrator of the Food Service Department. All employees were under her supervision, but the chef had primary responsibility for ordering food and supervising the kitchen staff. Cook assistant I was the entry level position in the Hospital C kitchen. Both the food service aide positions and the diet clerks were classified as cook assistant I. Workers in this designation were pot-washers, served on the tray lines, did some food preparation, delivered goods and snacks, and in the case of the diet clerk, did clerical work related to ordering appropriate nutrition for the patients. Many of the tasks of those working in the kitchen in either food preparation or service were similar. The food services manager had made it a goal to cross-train all Cook's assistant I workers.

Cook's assistant II workers had more responsibility and were required to have a much higher level of skills than level I workers. They did a lot of preparation work for cooks, ordered food from vendors and delivered food. Most workers in this category were promoted from the level I position or had food preparation experience elsewhere.

Dietary supervisors were responsible for overseeing the work of the dietary department. They were often promoted from the ranks of either level of cook's assistants. They were responsible for overseeing the work of the tray line, dishwashing, and clean up, and for implementing patient diet changes. Thus, the work of the diet clerk in keeping records of patient diets, diet changes, and menu selections was also under the supervision of the dietary supervisor.

Lab assistants played a prominent role in the central lab's processing of routine tests: complete blood counts (CBC tests), using state-of-the-art computerized instrumentation; routine urinalysis, using commercially developed test kits; and glucose scanning and glucose tolerance tests, using hand-held digital read-out equipment and test kits. For these and other such tests, lab assistants prepared the testing set-up, including slides and specimen preparation, and often ran the initial test; they worked alongside and/or under the close supervision and sign-off of licensed medical technologists. In most respects, their specimen-handling responsibilities more closely resembled that of lab technicians, whose license required an associate degree plus internship training. (This was the case at Hospital B, but Hospital A employed no lab. techs., requiring instead that all testing be conducted exclusively by med. techs., whose license required a 4-year degree plus an internship.) In addition, the lab assistants received on-the-job training and official certification in venipuncture, and had primary responsibility for all phlebotomy services -- again, with the close oversight of the supervising med tech. (For very complex procedures, either a specializing med tech or a physician would be summoned by the lab assistant.)

Nature and Competence of the Workforce

The workforce in the dietary department was very ethnically diverse. Many were Spanish speaking, some were Chinese, some Jamaican, some Anglo, and some were either African immigrants or of African American descent. There was a fairly even number of male and female workers, and they ranged in age from late teens to middle age. In general workers were competent to do the work required, although the two oldest workers were the only ones who had not been successfully cross-trained to do all of the cook's assistant I jobs in the kitchen. Few workers felt comfortable doing the diet clerk's job. Only two of the six or seven cook's assistant I's had been cross-trained at the time of the site visit.

Screening for hiring was done through a formal civil service process on the county level. The top seven applicants for any food service position were then interviewed by the administrator of the food service department. She had them fill out a set of forms in front of her and also required that they have a driver's license. The degree to which the paperwork was filled out appropriately influenced her hiring decisions. In filling the diet clerk's position, she looked for English reading and speaking ability, but she also liked the worker to know Spanish. She did not screen for math skills. The cook assistant I worker needed to be able to read and tally menus, know numbers, and be able to read recipes.

Reportedly some 70-80% of all candidates taking the county civil service exam pass. It was at that point that prior experience and personal qualities were screened by personnel and then referred to the lab's manager for final interviewing and decision. The high motivation and professional dedication of the lab assistants working at Hospital C was clear; screening for such qualities, however, was not always easy, according to the Personnel Department. The hospital had suffered a high turnover rate among lab assistants (as well as med. techs.), all of whom were able to find ready employment among the generally short-staffed hospital labs competing for experienced workers in that part of the country.

Like the dietary department, lab staffing reflects the region's great ethnical diversity. Of the three lab assistants, one was a female in her early 50's who came to America as a young child from Spain; another female in her mid-20's only recently immigrated from the Philippines; and the third, a native Honduran in his late 20's, immigrated soon after high school. (To complete the picture, the supervising med. tech. was a native of mainland China, and the other two central lab med. techs. with whom the lab assistants interacted daily were Philippino and Anglo.)

The job of the lab assistant at this hospital had an interesting beginning. The 50'ish lab assistant began in the lab over 11 years ago as the dishwasher; performing her cleaning tasks with unusual efficiency and enthusiasm, she soon began to suggest other ways in which she could be useful to the med. techs. Thanks to an enlightened attitude on the part of both management and union, the position of lab assistant was thus created at Hospital C, and today had grown into a 3 FTE position with an extraordinarily high degree of responsibility, professionalism, and collegial respect. (Interestingly, the first lab assistant still carried most of the responsibility for autoclaving hazardous waste and sterilizing tubes, pipettes, and other utensils for the entire lab.)

Because of the unique way in which the role of the lab assistant had evolved over the years, the hospital preferred candidates who had previous experience in hospital lab settings, and they were generally successful in finding at least minimally experienced applicants. The original lab assistant, who was now one of the most senior lab staff in terms of length of service, never finished high school; her female co-worker, who had been at Hospital C only a few months, was previously a med. tech. in the Philippines, and their male co-worker, who had been at the hospital for the last 18 months, initially worked part-time in the lab while moonlighting from his full-time lab assistant position at a larger hospital in the vicinity (he now moonlights there part-time).

Perspectives on the Literacy Requirements of Jobs

The food services administrator believed that the diet clerk position required higher literacy skills than did other cook assistant I positions and proposed to make that job a higher grade than the cook assistant I job. As was mentioned previously, few cook assistant I workers had been interested in being cross-trained into the diet clerk position. The supervisor had attributed this to a lack of interest in working closely with patients rather than to a lack of the basic skills to do the job. The job required paper work, office work, phone skills, and a great deal of interaction with patients. The diet clerks needed to have outgoing personalities, to like working with patients, and to be able to give careful attention to detail.

Lab assistants were required to read English fluently and learn complex procedures related to drawing blood and testing the specimens. Indeed, the testing procedures involved considerable reading-to-do: lab assistants had to follow instructions on commercial kits, utilize menu-driven software, use procedural manuals to guide testing steps, and fully comprehend all that was written on lab order slips. They assimilated a fairly extensive technical vocabulary, and became comfortable with numerical concepts. For example, they needed to understand the numerical readings provided by most of the lab's instrumentation; they needed to understand graphed results and have a general sense of statistical terms like mean, median, mode, range, and standard deviation, all of which were relevant in the daily quality control and equipment calibrating procedures they performed and in the utilization of the highly sophisticated instrument that reported such data as it processed approximately 80% of all lab tests. Lab assistants also calculated simple proportions in adding solutions to specimens during testing.

In addition, because of their role as phlebotomists, lab assistants were called upon to communicate (speak, listen, and effectively interact) with the diverse population served by the county hospital. Drawing blood required giving patients verbal instructions and being able to put them at ease so that blood vessels remained unconstricted: a tense, fearful, and/or hostile patient posed a dangerous situation, especially given the higher number of HIV patients the hospital served. Ideally lab assistants at Hospital C would be bilingual. Two of the three lab assistants (as well as other staff throughout the hospital) served as bilingual translators (for which they also received a small pay incentive), so that at any moment other departments could summon them for assistance in communicating with non-English speaking patients. Whenever feasible, the lab assistant's language skills were matched with those of the patients; dialogue between patient and lab assistant then reverted to the patient's native language or a combination of that and simple English.

Other Reading Requirements

All newly hired hospital personnel participated in a general orientation and were given a new employee handbook. The mean reading level according to the FORCAST readability formula for this handbook was grade 11.0. The new employee orientation materials were written on a grade 11.8 level. New workers were also, as county employees, required to read and sign a number of forms including a Loyalty Oath and elder and dependent adult abuse reporting agreement, and to become familiar with hospital policies on outside employment, forms delineating employees' rights to refuse to participate in an abortion, and other employment-related policies and forms. In general, benefits and policies were explained, and written handouts or forms to be filled were also provided.

Training Concerns

Training was done on the job by supervisors and experienced workers. In the food services department the policy was to cross-train all workers in a given job category so that any Cook's Assistant I, for example, could work at any job under that category. In actuality the diet clerk's position was not one to which all cook's assistants were cross-trained because the job tasks were clerical and interpersonal in nature, requiring different interests and skills from jobs involving food preparation and service.

Lab assistants were provided sequentially-based on-the-job training that resulted in their learning all aspects of the job. A procedures/training checklist guided the supervising med. tech. and lab manager in providing training that was properly ordered and in documenting that each new lab assistant had learned each aspect of the job. Training included a formal phlebotomy training program, which culminated in certification after approximately 3 months of concentrated training by the supervising med. tech. While all lab assistants knew all aspects of the job, a monthly schedule was posted, dividing up responsibilities (e.g., lab assistant #1 would typically do inpatient rounds, outpatient draws, and timed tests; #2 would do inpatient and clinic round, outpatient draws, and some instrument quality control; #3 would provide backup for lab assistants 1 and 2, run the lab's CBC and urinanalysis tests and otherwise assist the med. techs., as well as refill daily lab supplies and attend to the sterilization and hazardous waste disposal needs of the lab). Since this division of work was almost always consistent with the personal preferences of the three lab assistants, some level of specialization naturally occurred and was even valued. Nevertheless, because of the small size of the lab and the good relationships between staff members, each readily picked up for the other as workloads suddenly increased or whenever patient testing requirements indicated another lab assistant might be more effective in a given situation.

Actual Reading Requirements

Food service aides were required to read simple directions, food production sheets, recipes, labels and to write identification tags, such as labeling a snack with the name and room number of the person for whom it was prepared. The reading and writing tasks requiring the highest skills for this position were rated DOC 2, slightly higher than a 1 feature match. Diet clerks read menus and a variety of information on forms, and responded to written directions regarding patient diet changes and orders. They also filled in forms and patient card records, and accuracy was important in performing those tasks. The most difficult tasks involved prior procedural knowledge, and thus rated at the mid to high point on our scales, requiring considerably higher skills than the dietary aide job. Computation tasks involved simple measuring or addition and subtraction, and were rated at QUAN 2, the second level on our scale. New workers or workers in training in both the diet clerk and food service aide positions tended to ask how to do something rather than to refer to written materials for information. The diet clerk reported having the opportunity to look up information on patient diets in the Dietitian's Manual and to make decisions about food selections accordingly. In actual practice, most of the time she simply followed the menu ordering pattern for each patient's diet as prescribed dietitian on the patient's cardex file card.

The lab assistants at Hospital C were considered by the field observer to require the most complex technical skills with the highest criticality for accuracy, of any lab assistant jobs studied. The document reading tasks often involved reference to procedural information written in prose. The most difficult document reading task was near the top of our scale, rated at DOC 6. It entailed working with a high tech menu-driven instrument. The lab assistant dealt with three features of information at any given time, referring to a guidebook or a one page summary of information to determine normal parameters for machine test results. This task also required considerable analytical skills to determine whether reported results were routine or whether they required the immediate attention of the supervising med. tech.

The most difficult writing task involved the administrative processing of lab slips. This often required writing several sentences to document-relevant issues associated with obtaining patient blood or urine specimens. This was rated as prose 2b on our scales. The document writing task involved in filling our these slips was rated at DOC 4, a one feature match requiring procedural knowledge. It was of moderate difficulty on our scales. Oral language and interpersonal skills required for interacting with patients in drawing blood and performing lab tests were very high, much higher than those required of lab assistants positions that performed jobs more clerical in nature. These demands were probably not adequately captured in our rating (OL3) for this task.

The most difficult calculations entailed specimen preparation and required calculating ratios. These were rated at QUAN 4, slightly higher than the mid-point on our quantitative scale, and considerably more difficult than the computation tasks required of lab assistants at the other hospitals studied.

Summary

The need to address the challenges of having a multicultural workforce, some of whom were limited English speakers or readers, had resulted in creating systems within the dietary department in which job reading and computation tasks were kept simple and concrete. For example, menus were made up in such a way that high protein foods, high fat foods, low fat goods, high sugar items, and low sodium items were listed in a specified pattern. This enabled the dietitian to specify a menu ordering pattern for each patient, such as first selection in each menu category. When implemented this pattern resulted in the patient's dietary restrictions being met. This practice eliminated the need for the diet clerk to perform calculations or to analyze menu selections for conformance with dietary prescriptions. It also meant that there was less flexibility in addressing the patients' foods preferences when ordering their meals, but since this was a county hospital, doing so was not as high a priority as it might have been at a competitive private hospital.

More than at the other two hospitals studied, lab assistants at Hospital C relied on reading skills to guide testing procedures--not only because the volume of many kinds of tests was insufficient to allow certainty of recall for all memorized procedural specifications, but also because they performed more exacting roles in the analytical aspects of testing than the lab assistants observed at the larger hospital labs. Their required understanding and use of computational skills was also found to be greater than at the other two sites. Similarly, the oral language skill requirements were greater, due primarily to their extensive interaction with patients. Given the ethnic diversity of the patient population, bilingualism was highly desirable among these lab assistants.

It was also important to note that at Hospital C, where lab assistants had greater testing responsibilities and performed as phlebotomists, the unfailing performance of all tasks with complete accuracy seemed to be significantly more critical -- i.e., errors in action or judgment among these lab assistants appeared less likely to be detected before directly impacting upon the patient than at the other two sites where all testing procedures were the responsibility of degreed/licensed med. techs. (with or without an intermediate level of lab. techs.) and where computerized systems were in place to check results for logical consistency of test findings. Thus, the technical competence required of lab assistants at Hospital C seemed much higher than that at other hospitals studied. These job skill demands do not seem to be adequately captured in the rating assigned to the most difficult job tasks on our scales.

APPENDIX B

SAMPLE LITERACY TASKS

Using the conceptual framework developed by the creators of the NAEP Young Adult Literacy Simulation Tasks as part a point of departure, RMC Research developed scales for rating the difficulty level of job literacy tasks. These tasks were identified as either document reading and writing tasks, qualitative, prose or oral language tasks. They were placed at the appropriate point on the rating scales for each category. The following are selected tasks we observed at study sites. They provide examples of:

- high, medium and low difficulty tasks on the document scale; and
- high, medium and low difficulty tasks on the quantitative scale.

They have been selected from three different job sites; those of:

- tender/helper at Manufacturing Site B;
- dietary aide at Hospital Site B; and
- nutrition assistant at Hospital Site A.

The rationale for each rating is given, followed by the literacy materials used by workers in performing each task.

I. DOCUMENT TASKS

1. High level of difficulty: Dietary Assistant, Hospital Site A

1.1 WRITES Writes up diet change sheet daily, referring to Diet Change Board. This task requires checking the Diet Change Board, a chalk board on each hospital floor, containing parent information. It is checked mid-morning and mid-afternoon, but may change from hour to hour. The nursing staff calls in to the dietary assistant significant changes that may occur in the interim, such as holds on patient trays. The Diet Change Sheet records new admissions, transfers, and discharges. It must be signed by the nurse in charge on each floor. The dietary assistant must be alert to changes not recorded, and must actively seek information, listening to and speaking with floor staff to identify changes not yet recorded on the board or diet change sheet. (Attached)

Rating: **4E, DOC 7 Involves matching features, including Room/Bed, patient name, diet order, meal, discharge, admissions, comments, to from diet change order adding information from diet change board and any verbal information imparted by nursing staff over the telephone or in person.**

2. Medium level difficulty task: Dietary Aide, Hospital Site B

6.3 Task 6. Collect trays. This task includes all of the steps involved in removing the used trays from the rooms of patients and returning the trays to the kitchen.

6.3 Complete Intake and Output Chart -- if present.

As the dietary aide is leaving the room, he/she checks the door for an Intake/Output Chart (attached). If the patient has an intake and output chart posted on the door, then the dietary aide must examine the cups and dishes on the tray to determine what portion of the liquids and jello/pudding/sherbert/ice cream/hot cereal/watermelon the patient consumed.

[READ] The dietary aide may also consult the Fluid Measures Chart (attached) to determine what the size was of each serving the patient received.

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[COMPUTE] The dietary aide must look at the tray to estimate what portion of the serving the patient consumed (e.g., one half or one quarter)

[ANALYZE, COMPUTE] He/she then converts the portion consumed to milliliters (e.g., If the patient consumed one half of a large serving of milk, the dietary aide must consult the Fluid Measures Chart to determine that a large serving of milk is equal to two hundred fifty milliliters, and then he/she must calculate that one half times two hundred fifty is equal to one hundred twenty-five.

[READ, WRITE] The dietary aide then enters the number one hundred twenty-five on the Intake and Output Chart under the column heading Oral/Amount taken, next to the word "milk." The dietary aides that I observed performed these calculations in their heads.

Rating: **DOC 4 Three sub-tasks items which involve reading and writing, must match cup or dish to name on fluid measure chart and read the number of millimeters opposite this match. Must then enter the correct number in the appropriate place on the intake and output chart.**

3. Low level difficulty task: Teacher/Helper, Manufacturing Site B

Task 1 Supply feeder with fiber

1.1 Select bale READ style and number off label and compare with work order. Check date of fiber manufacture and inform operator so he can adjust machine according to heaviness of the fiber, etc. If fiber has been stored for a while, it gathers moisture, becomes heavier, etc. If rayon fiber, weigh before feeding and inform operator of weight to ensure correct blend.

Rating: **DOC 1. Matches style and number on tag to that on work order. One feature match with one exemplar.**

II. QUANTITATIVE TASKS

1. High level of difficulty task: Nutrition Assistant, Hospital Site A

6.6 CALC. Determines total patient caloric intake, including food eaten, I.V. and tube feedings. This entails figuring total number of calories taken in on various I.V. and tube formulas, which may be given 1/2 strength, 1/4 strength, full strength, etc. Must refer to table giving parental nutrition solution list of nutriments per cc, calculate the total number of calories consumed in a full strength solution (which entails multiplying decimals of up to 4 place, e.g., .0425 grams of protein per cc), then multiplying that product by .5 or .25, etc., according to the strength of the solution to arrive at the total number of calories. E.g., 1530 cc's of jevity = 67 g of protein (1530 x .044 = 67.32), 57 g of fat (1530 x .037 = 56.61), 233 g of carbohydrates (1530 x 232.56). Since both proteins and carbohydrates contain 4 calories/gram, add 67 + 233 = 300 grams x 4 = 1200. Fat contains 9 calories/gram. Multiply 57 x 9 = 513. Add 1200 calories plus 513 calories for a total of 1713 calories in a full strength jevity solution. Patient receives 1/2 strength solution. Thus, 1713 x .5 equals 857 calories per feeding. (See caloric intake worksheet.)

Some patients have I.V., tube feeding and food by mouth. All must be calculated and added up to figure total number of calories consumed.

Rating: **5C Quantitative 6 (or higher). Involves matching features from the I & O chart of the patient with exemplars from a table giving data concerning nutritional information of foods, and performing several operations involving multiplication. Also involves matching the features of formula name, amount taken, strength of formula, protein, fat, carbohydrate. Dietary assistants report that the task is further complicated by the fact that nurses do not use a standard set of abbreviations on the I & O forms.**

2. Medium level of difficulty task: Dietary Aide, Hospital Site B

Task 6. Collect Trays. This task includes all of the steps involved in removing the used trays from the rooms of patients and returning the trays to the kitchen.

6.3 Complete Intake and Output Chart -- if present.

As the dietary aide is leaving the room, he/she checks the door for an Intake/Output Chart (attached). If the patient has an intake and output chart posted on the door, then the dietary aide must examine the cups and dishes on the tray to determine what portion of the liquids and jello/pudding/sherbert/ice cream/hot cereal/watermelon the patient consumed.

[READ] The dietary aide may also consult the Fluid Measures Chart (attached) to determine what the size was of each serving the patient received.

[COMPUTE] The dietary aide must look at the tray to estimate what portion of the serving the patient consumed (e.g., one half or one quarter)

[READ, ANALYZE, COMPUTE] He/she then converts the portion consumed to milliliters (e.g., If the patient consumed one half of a large serving of milk, the dietary aide must consult the Fluid Measures Chart to determine that a large serving of milk is equal to two hundred fifty milliliters, and then he/she must calculate that one half times two hundred fifty is equal to one hundred twenty-five.

[READ, WRITE] The dietary aide then enters the number one hundred twenty-five on the Intake and Output Chart under the column heading Oral/Amount taken, next to the word "milk." The dietary aides that I observed performed these calculations in their heads.

Rating: **QUAN 4. Computing process requires 1 operation involving multiplication.**

3. Low level of difficulty task: Teacher/Helper, Manufacturing Site B

3.9 Weigh roll and inform operator of weight. Operator writes weight on tag.

Rating: **QUAN 1. Weighing item, no data entry required. Lesser skill.**

HOSPITAL SITE A: DIET CHANGE SHEET

UARCO Business Forms - Rx

DIET ORDER SHEET

PATIENT CARE UNIT: 10

DATE: 4 / 11 / 89

Please have ready at 6:30 A.M. (Breakfast Service); 10:45 A.M. (Lunch Service); 3:45 P.M. (Dinner Service). Changes received after these times will be implemented at the next meal.

	PATIENT NAME	DIET ORDER	BREAKFAST		LUNCH		DINNER	
07	Jones	2gm Na	NPO					
14A	Smith	Nas						
14B	Louise	↓chol	FBS					
14C	Cooper	Hse						
14D	Hepburn	40gmpro 2gm Na						
15	Kelly	Hse						
16	McManus	↓K 1500cc						
17	Tyrone	Nas						
18	Mitchell	Nas ↓chol						
19	Grady	1800cal DB	FBS					
20	Probelzkewik	Hse						

VERIFIED BY			Time / Sign		Time / Sign		Time / Sign
	NURSING/CLINICAL ADMINISTRATION						
	DIETETICS						

DISCHARGE			ADMISSIONS				OTHER ORDERS COMMENTS
ROOM/BED	NAME	TIME	ROOM/BED	NAME	DIET ORDER	✓IF HERE	

HOSPITAL SITE B: INTAKE AND OUTPUT CHART

DATE

NAME

INTAKE

OUTPUT

PARENTERAL				BLOOD, PLASMA OR DEXTRAN		ORAL				URINE			MISC. OUTPUT			
Time	Amount & Type Started	Hourly Amount Absorbed	Cumulative Amount Absorbed	Type and Amount Started	Cumulative Amount Absorbed	Type	Amount Taken	Cumulative Total	Volume	Cumulative Total						
7- 8 AM																
8- 9																
9-10																
10-11																
11-12 N																
12- 1 PM																
1- 2																
2- 3																
8° TOTAL																
3- 4																
4- 5																
5- 6																
6- 7																
7- 8																
8- 9																
9-10																
10-11																
16° TOTAL																
11-12																
12- 1 AM																
1- 2																
2- 3																
3- 4																
4- 5																
5- 6																
6- 7																
24° TOTAL	☒	☒		☒		☒	☒		☒		☒	☒				

HOSPITAL SITE B: FLUID MEASURES CHART

FLUID MEASURES
30 ml. = 1 oz.

CONTAINERS	ml
Soup mug	180
Brown plastic mug	200
Small plastic cup	125
Large plastic cup	250
Styrofoam cup	250
4 oz. milk container	125
8 oz. milk container	250
4 oz. P.C. juice	125
FOOD SERVINGS	
Watermelon	160
Serving Jello (or Diet Jello)	125
Serving custard/pudding	125
Sherbet/container	125
Ice cream/container	125
Water ice/container	90
Popsicle	90
Hot cereal/milk	60
Cereal-gruel	90

TEAM TRAY SERVICE

- Pencil, I & O card, box.
- Know your floors and the order.
- Wait for trucks in kitchens only.
- Check trays for missing items.
- Check doors for NPO or PRECAUTION.
- ALWAYS check armbands.
- Knock if door is closed. Ask for permission to enter if curtain is drawn.
- Clear dirty trays from room.
- No coffee on R9W or CICU.

DO NOT BREAK ON FLOORS.

When picking up:

- leave Diabetics and Calorie Counts for the Dietetic Assistant.
- record all I & O's on door.
- put trays inside food truck.

TEAM I	TEAM II
R1	R2/P2A
P1C	R3
P3A	P3C-D
R5	R4
R7	P4C-D
R9/CICU	R6

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HOSPITAL SITE A: CALORIC INTAKE WORKSHEET

4/5 [redacted] Hospital

Name

DIETARY DEPARTMENT
CALORIC INTAKE

5/2

AMT.	A FOOD	PRO	FAT	CHO
TF	Jevity			
1630	1713 cal	67	57	233
IV	D 5½			
1250	214 cal			63
TF	1713	67	57	233
IV	214			63
Total	1927 cal	67	57	296
3	B	5/2		
Name				
	oatmeal	2		15
	bran muf	4	5	24
	chol eggs	6	5	
	or juice			15
		12	10	54
	½ chix leg	11	8	
	cd pears			10
	Sherbet Shake	1	9	47
		24	27	111
	~~[illegible]~~ chix leg	21	15	
	asparagus			10
	½ custard	7	1	6
	2 juice	52	43	187
PO	1345 cal.	50	45	185